A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

JULY, 1938

GENERAL PHYSICS.

ADSORPTION (see Surface Properties).

ATOMIC AND MOLECULAR STRUCTURE.

2644. Rotation of the Atomic Nucleus. E. Teller and J. A. Wheeler. *Phys. Rev.* 53. *pp.* 778–789, *May* 15, 1938.—The spacing of the levels in the fine structure of α- and β-ray processes and the existence of metastable nuclear states (isomers, isobares) are in contradiction with the existence of low lying levels corresponding to the rotation of the nucleus as a whole. The exchange of the nuclear constituents effected through rotation, together with the fact that the particles are not rigidly bound to equilibrium positions in the nucleus, will in some cases forbid, in other cases perturb the lowest levels, and cause the first state of excitation to lie considerably higher. Simple models illustrating these effects are discussed. An estimate is made for the position of the lowest excited level for heavy nuclei. It is found to vary inversely with the mass. AUTHORS.

2645. Saturation of Nuclear Forces. C. Critchfield and E. Teller. *Phys. Rev.* 53. *pp.* 812–818, *May* 15, 1938.—The forces between heavy elementary particles, *i.e.*, neutrons and protons, are investigated on the hypothesis that they emit electron-positron pairs. It is also assumed that the interaction of the heavy particles with the field of light particles is large compared with the kinetic energy of the light particles. It is shown that potentials result which are of the same order of magnitude as the kinetic energy of the light particles. When many heavy particles interact the total potential energy is found to be proportional to the number of heavy particles. AUTHORS.

2646. Energy Content of the Heavy Nuclei. A. J. Dempster. *Phys. Rev.* 53. *pp.* 869–874, *June* 1, 1938.—A packing fraction curve is constructed from the atomic masses previously measured and from new measurements for Sn, La and Nd. The curve is also drawn to agree with the differences in packing fractions for the 25 pairs previously reported. The curve has the general shape of Aston's curve, but has a higher minimum value of $-7\cdot2\times10^{-4}$ in place of -10×10^{-4} and is from 2×10^{-4} to 3×10^{-4} higher for the heavy elements. For the elements below lead the curve is much less steep than above. This gives an energy content to these elements, such that α-ray emission is impossible. With the values given by the curve for Sn and Pd, the differences between the masses of Pb and Th, and Pb and U are greater than the total mass of the α- and β-rays emitted in the transformations from Th or U to Pb, but agree with the differences to be expected if the mass equivalents of the energies of the α- and β-rays are allowed for. The effect of the packing fractions on the computed atomic weights of the elements Lu, Nd, Th and U is discussed. The masses of Au and Sn isotopes have been compared, and the masses of Nd, La and Sn isotopes have been compared with Ti. AUTHOR.

2647. Heavy Electrons and Theories of Nuclear Phenomena. G. Wentzel. *Naturwiss.* 26. *pp.* 273–279, *May* 6, 1938.—Observations on cosmic rays establish definitely the existence of a new type of charged particle which probably has a mass of between 100 and 300 electronic masses. If these particles have Bose-Einstein statistics and spin 1, they could be used to explain nuclear forces as due to the exchange of such a particle between neutron and proton. In order to account for the observed proton-proton forces, the existence of neutral particles of similar properties in addition to that of heavy electrons would then have to be postulated. The heavy electrons can also be thought of as forming an intermediate stage in the process of β-decay. However, this view does not lead to satisfactory results for the shape of the β-ray spectrum. A good description of the spectrum can be obtained by postulating the existence of a charged particle of approximately proton mass, but integer spin. Any such theory would affect Heisenberg's conclusions as regards " bursts," *i.e.*, processes involving the simultaneous creation of many light particles in collisions between cosmic rays and atoms. R. P.

2648. Theory of Heavy Electrons and Nuclear Forces. H. J. Bhabha. *Roy. Soc., Proc.* 166*A*. *pp*. 501–528, *June* 16, 1938.—A theory is developed based on the idea that the proton and neutron are two states of the same particle, which can go over from one state to the other by the emission of a charged particle of mass intermediate between those of the proton and electron, as originally suggested by Yukawa. These " U-particles " are described by four wave-functions. Quantisation of the theory leads as usual to positive and negative U-particles with a spin of one unit. The U-particles are identified with the heavy electrons of cosmic radiation. The theory leads uniquely to short range forces of the Heisenberg and Majorana type of such a sort as to allow one to make the ground state of the deuteron the triplet state, *the sign of the Majorana force being not at our choice*. The range of the forces is connected with the mass of the U-particles as before, and demands a mass of some 200 times the electron mass. The relativistic generalisations of a pure Heisenberg and pure Majorana force are given. The relativistic scattering of U-particles by protons and neutrons is calculated. The theory also leads to showers of Heisenberg's type, but consisting mainly of heavy electrons, a few electrons, and some heavy particles. AUTHOR.

2649. Application of " Reciprocity " to Nuclei. M. Born. *Roy. Soc., Proc.* 166*A*. *pp*. 552–557, *June* 16, 1938.—The formula for the distribution of quantum states, which follows from the principle of reciprocity and the assumption of a closed p-space [see Abstract 1852 (1938)] is applied to some properties of nuclei. The results can be considered as confirmations of the hypothesis. The mass of a particle moving with velocity of light and maximum momentum is of the same order as that of the particles which Yukawa has introduced. [See Abstract 1306 (1938).] AUTHOR.

2650. Attempt at a Theory of the Nucleus. F. J. Wiśniewski. *Acta Physica Polonica*, 6. 4. *pp*. 335–345, 1937. *In French*.—A model of the nucleus, in which the total number of neutrons and protons is a multiple of 3 is proposed. Mass deficiencies, calculated in accordance with the theory, agree well with experimental values. A theory of nuclear magnetisation, utilising certain constants involved in the calculation of mass deficiencies, is developed. The value of the radius of a nucleus containing n neutrons and protons is given by $1\cdot378 \times 10^{-13}(n-1)^{1/2}$ cm. This gives for Ra ($n = 88$) a nuclear radius equal to $1\cdot285 \times 10^{-12}$ cm. Two protons attract or repel according as their distance apart is $<$ or $>$ $2\cdot14 \times 10^{-12}$ cm. respectively. J. S. G. T.

2651. Mass Numbers of Stable Isotopes of Elements 43, 61, 85 and 87. R. Grégoire. *Comptes Rendus,* 206. *pp.* 1477–1478, *May* 16, 1938.—Comparison of the isotopic numbers ($I = A-2Z$) of the 62 stable isotopes of the 42 elements with odd atomic number leads to the inference that the stable isotopes of element 43 are those with mass numbers 97 and 99; of 61 those with 145, 147 and perhaps 149; of 85, 213, 215 and perhaps 217; and of 87, 219 and 221. C. A. S.

2652. Influence of Background on the Determination of Atomic Distances in Molecules by Electron Diffraction. C. Finbak and O. Hassel. *Zeits. f. phys. Chem.* 39. *Abt.B.* 5–6. *pp.* 471–475, 1938.—The influence of the background upon the apparent position of maxima and minima in electron diffraction patterns is discussed. This background intensity is not uniform but falls off with increasing angle of scattering, and therefore the true diffraction maxima and minima are superimposed upon a background intensity curve. As a result the maxima appear nearer and the minima further away from the central spot than would be the case if there was no background. This effect diminishes with increasing angle of scattering and it is shown that by extrapolating to $s = \infty$ for both maxima and minima, the true distance of atomic separation can be determined. A. G. Q.

2653. Molecular Structures of the Methyl Derivatives of Phosphorus and Arsenic. H. D. Springall and L. O. Brockway. *Am. Chem. Soc., J.* 60. *pp.* 996–1000, *May,* 1938.—By electron diffraction investigation of the gases, the structures of PMe_3 and $AsMe_3$ have been determined. The molecules are pyramidal with the P and As atoms at the respective apices. PMe_3 has a bond angle of 100 ± 4° with the P–C bond $= 1{\cdot}87 \pm 0{\cdot}02$ Å; $AsMe_3$ has a bond angle of 96 ± 5° with the As–C bond $= 1{\cdot}98 \pm 0{\cdot}02$ Å. These distances agree with the sums of the covalent radii given by Pauling and Huggins. From these results a firmer basis is obtained for the discussion of the bond shortening in the corresponding chlorides. AUTHORS.

2654. Constitution of Heavy Water. I. R. Rao and P. Koteswaram. *Indian Journ. Phys.* 12. *pp.* 63–74, *March,* 1938.—The Raman band of D_2O is found to be similar to that of H_2O both in diffuseness and extent. The variations with temperature in the structure of this band are also similar to those of H_2O. These changes are attributed to changes in the relative proportions of D_2O, $(D_2O)_2$ and $(D_2O)_3$ molecules which are assumed to be in thermal equilibrium. By an analysis of the intensity curves of the band, the proportions of the three polymers at different temperatures are calculated. The results are compared with those of water and the points of similarity and differences explained on the basis of their other physical properties. AUTHORS.

***2655. Molecular Association Studied in the Infra-Red. J. Errera and H. Sack.** *Faraday Soc., Trans.* 34. *pp.* 728–742, *June,* 1938. An infra-red spectrometer is described, using a Zeiss mirror-monochromator, and its precision is discussed. Association phenomena, implying an O–H bond, are studied: the association of alcohols in CCl_4 or CS_2 may be explained by formation of double molecules and complexes of a higher order; the latter vanish rapidly in increasing the temperature by 30–50°. In dioxane, acetone and pyridine the alcohols (aliphatic and aromatic) form complexes with the molecules of the solvent, which change but very little with temperature and which still exist in dilution (ternary mixtures). The case of chelation is studied again (salicylaldehyde) and attention is drawn to the fact that association and especially chelation increase the symmetry of the O–H bond and makes the harmonics less intense. In dioxane the chelated character is "loosened." AUTHORS.

2656. Formation of Helium Molecules. F. L. Arnot and M. B. M'Ewen. *Roy. Soc., Proc.* 166*A*. *pp.* 543–551, *June* 16, 1938.—An investigation of the formation of ionised molecules in A, Ne and He has been made by the balanced space-charge method which had previously been used by the authors to study the formation of Hg_2 molecules [see Abstract 910 (1938).] No evidence of molecular ionisation was found in A and Ne. In He molecular ionisation sets in at the resonance potential. The results show that these molcular ions are formed by the attachment of metastable atoms to normal atoms according to the process $He(1s^2, {}^1S_0) + He'(1s2s, {}^3S) \rightarrow He_2^+(1s\sigma^2 2p\sigma, {}^2\Sigma_u) + \epsilon$. The appearance potential of the molecular ions is the energy of the 2 ^3S state, 19·77 V, which is 1·19 V greater than the ionisation potential of the He_2 molecule. Attention is drawn to the fact that these molecular ions are formed from excited atoms in S-states, whereas the authors have shown that Hg_2^+ ions are apparently formed only by excited atoms in P-states. AUTHORS.

See also Abstracts 2686, 2690, 2712, 2747, 2825, 2877, 2901, 2918, 2953, 2987, 2999.

COLLOIDS.

2657. Colloidal Silver. R. Spychalski. *Kolloid-Beihefte*, 47. 9–12. *pp.* 321–370, 1938.—The author gives an account of various methods of preparing Ag hydrosols and describes a technique for their microscopic examination, using a new form of the Siedentopf-Zsigmondy slit-ultramicroscope. An investigation of the accuracy of the method of ultramicroscopic enumeration showed that for mono-disperse Ag sols, containing green or blue particles, the average error was 10–15%. The method was not found to be suitable for estimating poly-disperse sols containing particles of many colours. The effect of Na_2CO_3 on the process of formation of Ag sols from Ag_2O and $AgNO_3$ solutions was investigated. It was found that reproducible mono-disperse sols could be obtained by the reduction of solutions of Ag_2O with hydrazine hydrate and of $AgNO_3$ with hydrazine sulphate. With both Ag_2O and $AgNO_3$, hydrazine sulphate gave finer particles than did the hydrate. The colours of the various sols obtained by use of different reducing agents were also studied. The conditions for the formation of derived Ag sols by the reduction of $AgNO_3$ in the presence of amicroscopic nuclei, formed by the action of P on a dilute solution of Ag_2O or $AgNO_3$, were examined, and it was found possible to produce mono-disperse sols in which the number of derived particles, which could be counted with the ultramicroscope, was proportional to the concentration of amicroscopic nuclei. W. H. WAL.

2658. Flow of Viscous Substances. W. Philippoff. *Kolloid Zeits.* 83. *pp.* 163–172, *May*, 1938.—After discussion of flow relationships in the case of plastic substances [see also Abstracts 3016 and 3017 (1936)], series of structure-viscosimetric and optical-polarisation experiments are described for many different types of system. It was established for the non-Newtonian liquid sodium oleate-water and V_2O_5 sol (2 days old) that a laminated stationary flow occurs in agreement with earlier experimental results. In the case of jellies (mercury sulphosalicylic acid, cotton yellow and cellite in benzyl alcohol) a psuedo-laminated flow was observed, which arises from the flow of gel-particles, and depends on the apparatus employed. Swarm-formation was observed in the case of the V_2O_5 sol which can giverise to pseudo-laminated flow. In two cases (cellite in benzyl alcohol and oil colour) a slip was established and the thickness of the layer estimated. Finally a viewpoint was discussed for the evaluation of the material constants of colloidal solutions from viscosity measurements. H. H. Ho.

2659. Diffusion of Cellulose Derivatives. A. Polson. *Kolloid Zeits.* 83. *pp.* 172–180, *May*, 1938.—An apparatus is described for the measurement of diffusion by Lamm's method. The diffusion constants were measured for methyl cellulose in aqueous salt-solution and for acetyl cellulose in acetone. The courses of the diffusion curves have enabled a swelling effect to be established. Relationships have been derived for the determination of the diffusion constants, which lie sufficiently near to the theoretical values. The diffusion constants of the methyl celluloses have been utilised to calculate molecular weights from the different ultra-centrifuge data of Signer and his co-workers. Satisfactory agreement is found between the molecular weights calculated from the sedimentation and diffusion constants, and those derived from the sedimentation equilibrium. An attempt is made to evaluate the axial relationships of the ellipsoidal molecules of the methyl celluloses from the data now obtained. H. H. Ho.

2660. X-Ray Examination of Fine Particles and Colloidal Suspensions. A. Guinier. *Comptes Rendus*, 206. *pp.* 1374–1376, *May* 9, 1938.—The intensity of radiation diffused by various substances in directions making a very small angle with that of the incident X-ray is measured as previously described (the whole apparatus being *in vacuo* or in H_2) [see Abstract 2692 (1937).] The results obtained or to be expected, for various materials, *e.g.*, carbon in various forms, dried silica gel, gum arabic, caoutchouc, colloidal solutions, etc., are described, as also the application of the method to phenomena of adsorption, catalysis, etc. C. A. S.

2661. Flow Potentials, Electro-Endosmosis and Electrophoresis with Platinum. H. R. Kruyt and J. Oosterman. *K. Akad. Amsterdam, Proc.* 41. 4. *pp.* 370–374, 1938.—Previous work [see Abstract 3243 (1937)] had indicated that the measurement of flow potential on a Pt capillary was complicated by polarisation phenomena and that ultimately the potential in the flow cell became zero if the flowing liquid had the composition 10^{-4} *N*HCl + 1% quinhydrone. The following problems are now solved: (1) The disappearance of electrokinesis in measurements of electro-endosmosis and of flow potentials on metal capillaries, and its existence in the case of glass capillaries. (2) The appearance of electrokinesis in the case of electrophoresis of platinum sols but not in measurements of flow potentials and electro-endosmosis on platinum capillaries. (3) The absence of a disturbing influence by polarisation in the case of electrophoresis and its presence on measurements of flow potentials. Experimental details are included in the paper. H. H. Ho.

***2662. Ultra-Filters of Graduated Porosity. J. Duclaux and M. Amat.** *Comptes Rendus*, 206. *pp.* 1475–1477, *May* 16, 1938.—Nitro-cellulose dissolved in an aqueous solution of Mg perchlorate is coagulated on contact with water. This property has been utilised by the authors in a new method for the production of porous membranes. The porosity of these membranes is determined mainly by the initial concentration of the solution of nitro-cellulose and the authors claim that the method of preparation enables reproducible results to be obtained. W. H. Wal.

2663. State of Solution of Soaps. Part I. Specific Volume of Dilute Sodium Oleate Solutions. M. Ulmann. *Zeits. f. phys. Chem.* 182. *Abt.A.* 1. *pp.* 18–30, 1938.—Determinations of the specific volumes of aqueous solutions of sodium oleate over the concentration range 0·005–1·2% using a sensitive float method and thence up to 16·85% using a pyknometer show three well-defined regions in which the specific volume is a linear function of the concentration. Solutions of the middle region (from 0·025 to 0·9%) are sensitive to shaking, the specific volume immediately after mechanical disturbance being lower than that observed for a solution which has been left at rest for several days. Solutions containing excess alkali show a corresponding behaviour. L. A. W.

2664. Chemical Properties of Aerosols. R. E. Liesegang. *Kolloid Zeits.* 83. *pp.* 217–221, *May*, 1938.—The author discusses the origin and variety of particulate matter in the atmosphere. The condensation of water vapour on hygroscopic and other particles is considered, with particular reference to the formation of rain and snow. Physiological effects of inhaling dust, and their possible dependence on the solubility of the particles in the lung fluids, are also considered. A number of references are given. W. H. Wal.

2665. Crystal-Size in Metal and Metal-Oxide Smokes. D. Beischer. *Zeits. f. Elektrochem.* 44. *pp.* 375–385, *June*, 1938.—The sizes of the primary crystals in a series of metal and metal-oxide smokes were determined from X-ray and electron-diffraction patterns, and by a Ruska magnetic electron microscope. A comparison of the X-ray and electron-diffraction diagrams showed the electron-diffraction method to be applicable only for crystal sizes less than about 100 Å. The electron microscope gave good general photographs, and, in some instances, the primary crystals forming the colloidal aggregates were shown. The smallest primary particles in the smokes which were investigated were from 50 to 100 Å in size. It must be assumed that the original nuclei were still smaller. W. H. Wal.

2666. Trajectory of Ash Particles in Air and the Determination of their Size. K. Prosad and D. N. Sen. *Phil. Mag.* 25. *pp.* 993–1003, *June*, 1938. *Supplement.*—The paper is concerned with the theoretical and experimental investigations of the trajectory of cigar ash particles shot out in a horizontal direction in air, from a narrow orifice by effluent air under a measured driving pressure in the form of a jet. The theoretical and experimental curves fit in very well. From the investigations made, it has been found possible to determine the average size of the ash particles, assumed spherical, which, as a result of coagulation, must be growing in bulk rapidly during their flight. The experimental value of the radius has come out to be $2 \cdot 34 \times 10^{-3}$ cm., and is considered satisfactory. The method is claimed to be a novel one and admits of extension and application to the study of the general problems of "smokes" and "aerosols" under different conditions. The present study has suggested further extension of the problem by taking simultaneously into account (*a*) initial particles of different sizes, and (*b*) growth of the particles under flight in the same effluent jet. These and other aspects noted in the body of the paper are now under investigation. Authors.

See also Abstracts 2740, 2741, 2995.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

2667. Computation of Three-Dimensional Fourier Syntheses in Crystal Structure Analysis. T. H. Goodwin and R. Hardy. *Phil. Mag.* 25. *pp.* 1096–1104, *June,* 1938.—Two-dimensional Fourier projections of crystal structures may not lead to complete resolution of all the atoms. Three-dimensional syntheses do so. The method of computing such a synthesis is described for the most general case (no symmetry centre). Special reference is made to summation along lines such as (x_1y_1z) and over planes such as (xyz_1). AUTHORS.

2668. Perturbations in Crystal Lattices. J. Cichocki. *J. de Physique et le Radium,* 9. *pp.* 129–132, *April,* 1938.—In a theoretical study of the reciprocal transition of two atoms in a crystal lattice the heat of auto-diffusion of a pure metal is calculated and also the heat of diffusion in the case of solid solutions, taking into account the energy of perturbation due to the substitution of a stranger atom into the lattice of the solvent. In the calculation it is assumed that during the transition the atoms should approach each other to such a degree that the initial atomic volume is halved. The heat of auto-diffusion is the energy corresponding to this compression and the heat of diffusion in solid solutions is equal to this work less the difference of energies of perturbation of the elementary polyhedra before and after transition. Applying these calculations to the perturbation energy of salt lattices the author obtains the energy of penetration of slow electrons into a salt lattice. J. I.

2669. Electronic Structure of Alloys. T. Muto. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 772. *pp.* 377–390, *April,* 1938. *In English.*—In general the results of H. Jones [see Abstracts 3876 (1936) and 2719 (1937)] depend on the tacit adoption of Fourier expansion for deduction of the Brillouin zones, so that they are valid only for periodic distribution of the component atoms in the lattice, or for cases where the proportion of solvent atoms is too small to affect the crystal structure appreciably. Mott's results for the magnetic properties and specific heats of transition metals [see Abstract 4327 (1936)] depend on the assumption that the Brillouin zone structure remains unaltered on alloying, apart from changes in the electron distribution which occur. This is probably valid only for metals with nearly similar atomic volumes, fields and crystal lattices. Slater [see Abstract 3345 (1937)] and T. Hirone [*Inst. Phys. and Chem. Research, Tokyo, Bull.* 16, *p.* 1409, 1937] have discussed magneton numbers of ferromagnetic alloys. The author, using Nordheim's virtual method [see Abstract 3907 (1931)] compares the results obtained for the Brillouin zones and other properties with those obtained by previous methods, discussing critically the method of Jones and Mott. D. R. H.

2670. $\alpha \rightleftarrows \beta$ Transformation in Manganese. G. Johannsen and H. Nitka. *Phys. Zeits.* 39. *pp.* 440–445, *June* 1, 1938. *From the Reichsanstalt.*—The transformation is investigated by cooling curves, thermal dilatation, resistance temperature curves, and powder photographs (*a*) at high temperatures, (*b*) on quenched samples. The point at 862° observed by thermal analysis depends on a supercooling of the β phase. In an alloy containing 94·25% Mn, 3·2% Fe, 0·97% Si, 0·25% C, 0·13% P, the $\alpha \rightleftarrows \beta$ change occurs at 640°–650° C. on cooling, and between 750° and 800° C. on heating; in 99·95% Mn it lies between 640° and 710° C. on cooling. Lattice constants, determined in a camera of 12 cm. dia. with Fe $K\alpha$ radiation gave for α Mn at 725° $a = 9{\cdot}121 \pm 0{\cdot}004$ A, $\alpha = 3{\cdot}7 \times 10^{-5}$ between 20° and 725°; for β Mn at 760° $a = 6{\cdot}488 \pm$

0·005 Å, $a = 4 \cdot 2 \times 10^{-2}$ between 20° and 760°, the measurement at 20° C. being made on a quenched specimen. Thirteen references are included. [Thermal curves are not plotted according to the conventional method.]

D. R. H.

2671. X-Ray Study of the Fe-Ni-Al Ternary Equilibrium Diagram. A. J. Bradley and A. Taylor. *Roy. Soc., Proc.* 166*A*. *pp.* 353–375, *June* 3, 1938.—X-ray powder photographs of slowly cooled alloys of Fe, Ni and Al have been used to construct a phase diagram for all compositions. The system falls into two distinct portions. Up to 50 atomic % of Al there are only body-centred cubic and face-centred cubic structures. Beyond 50% of Al, the diagram is extremely complex and will be described in a later paper. The face-centred cubic phase field includes superlattice structures related to Ni_3Al or Ni_3Fe (α_1), as well as disordered structures (α). It encloses a miscibility gap where two face-centred cubic superlattice phases (α_1 and α_1') are in equilibrium. As the Fe content increases, the gap closes. The body-centred cubic phase field includes superlattice structures related to Fe_3Al (β_1) and FeAl or NiAl (β_2). There is a two-phase field where the Fe-rich β phase (without a superlattice) is in equilibrium with the β_2 phase. In consequence, the system is much more complicated than had previously been supposed. Instead of a two-phase field separating the face-centred cubic and body-centred cubic areas, there are four separate areas, comprising three two-phase fields and a three-phase field. In the latter a face-centred cubic structure (α) is in equilibrium with two body-centred cubic structures (β and β_2). The two-phase fields are $\alpha + \beta$, $\alpha + \beta_2$ and $\beta + \beta_2$ respectively. The corners of the three-phase triangle are placed at the following compositions: α, 62, 31, 7; β, 90, 7, 3; β_2, 28, 41, 31. (The numbers represent atomic % Fe, Ni and Al respectively.) AUTHORS.

2672. Atomic Rearrangement Process in the Copper-Gold Alloy Cu_3Au. Part II. F. W. Jones and C. Sykes. *Roy. Soc., Proc.* 166*A*. *pp.* 376–390, *June* 3, 1938.—The relation between the size of nuclei and electrical resistance has been determined for the alloy Cu_3Au in both the annealed and cold-worked states. The experimental results are interpreted, using the hypothesis that nuclei are antiphase with narrow boundaries. For large nuclei a linear relation, between resistance and the number of boundaries per unit length, is found from which the reflection coefficient of a single boundary has been deduced. This reflection coefficient is the same for both cold-worked and annealed material, although the rates of growth of the nuclei in the two cases differ considerably. [For Part I see Abstract 4475 (1936).] AUTHORS.

2673. X-Ray Study of Lattice-Distortion in Rhodium. G. W. Brindley and P. Ridley. *Phys. Soc., Proc.* 50. *pp.* 501–518, *July* 1, 1938.—Measurements of the intensities of X-ray reflections from filed and chemically prepared specimens of Rh powder are made relatively to each other and are then converted to absolute units by comparison with suitable Al reflections. The scattering factors, f_T, obtained experimentally for both types of powder agree satisfactorily for the higher order reflections, with a theoretically estimated scattering factor, but for the lower order reflections the experimental values are markedly low, which suggests the existence of appreciable primary extinction. Detailed calculation shows that the variation of $[f_{T(\text{filed})}/f_{T(\text{chem.})}]$ with $(\sin \theta)/\lambda$ can be accounted for almost entirely in terms of primary extinction, and that there is very little residual effect due to lattice-distortion of the kind found in similar experiments with Cu and Ni. Measurements of the widths of the reflections are made for both types of powder ; for the filed powder a total of 23 reflections for five radiations are measured. The results are discussed in relation to various theories of the nature of lattice distortion produced in metals by cold-work. The results are shown to be incompatible with the view that the broadening is due to smallness of crystal-size since the observed widths when plotted against θ fall on or near a mean curve, whereas with small crystal broadening there should be a separation according to wave-length. The difficulties attendant on any explanation in terms of periodic or semiperiodic lattice-distortion which have been discussed by Boas are briefly outlined. It is shown that the observed results may be explained in terms of a variation of the lattice spacing about the normal mean value due to the stresses caused by the filing process. Assuming a Gaussian distribution for the variation $(\delta a/a)$, the spread of the distribution is calculated. In this calculation there is only one adjustable parameter and this fixes the spread of the distribution. From this distribution a calculation is made of the internal energy of the worked metal. AUTHORS.

2674. Structure of Cd-In Alloys Rich in In. W. Betteridge. *Phys. Soc., Proc.* 50. *pp.* 519–524, *July* 1, 1938.—The solubility of Cd in In has been determined by X-ray diffraction methods as 14·5 ± 0·5 atomic % at 100° C. and 4·5 ± 0·5 atomic % at 20° C. The axial ratio of the face-centred tetragonal lattice of the In-rich solid solution has been found to decrease with increasing Cd-content, until at 4·5 atomic % the structure becomes face-centred cubic. No change in the volume of the In atom is associated with the change in axial ratio. AUTHOR.

2675. Accurate Determination of Lattice Constants of Hygroscopic LiCl and NaBr. A. Ieviņš, M. Straumanis and K. Karlsons. *Zeits. f. phys. Chem.* 40. *Abt.B.* 1–2. *pp.* 146–150, 1938.—The precision method previously developed [see Abstract 991 (1936)] is used, the salt being caught on the surface of a glass or silica rod by rotating the latter in a tube containing it, the whole having been previously dried ; the lines obtained are not inferior in sharpness to those normally produced. With slight modification the method could be used for substances oxidised in contact with air. LiCl gives 5·12952 ± 0·00004 A at 25° C. with $\alpha = 4{\cdot}476 \times 10^{-5}$ and NaBr 5·96095 ± 0·00005 A with $\alpha = 4{\cdot}252 \times 10^{-5}$. The authors claim a precision about a hundred times as great as in previous results [see Abstracts 1032 and 1755 (1923).] D. R. H.

2676. Changes in Parameter of Alkali Halogen Lattices Due to Foreign Ions. E. Saur and O. Stasiw. *Göttingen Nachrichten, Fachgruppe II.* 3. 7. *pp.* 77–83, 1938.—The introduction of small amounts of KH into KBr crystals causes a change in lattice parameter which is consistent with the formation of a mixed crystal. A similar result is obtained when TlCl is introduced into the KCl lattice. In both cases the changes in parameter are less than would be expected from the additive law of Vegard. J. I.

2677. Structure of Sodium Isocyanate. M. Bassière. *Comptes Rendus,* 206. *pp.* 1309–1311, *May* 2, 1938.—To obtain crystals of this substance of sufficient size for an X-ray examination it is necessary to crystallise from a solvent composed of alcohol (100 gm.), water (200 gm.) and NaOH (20 gm.). In this solvent the substance is only weakly hydrolysed even at boiling point. The crystals are rhombohedral with unit cell dimensions etc. as follows, $a = 5{\cdot}44 \pm 0{\cdot}01$ Å, $\alpha = 38°22' \pm 4'$ or for the corresponding hexagonal cell, $a = 3{\cdot}576 \pm 0{\cdot}005$ Å, $c = 15{\cdot}10 \pm 0{\cdot}02$ Å; one mol. per unit cell, density (calc.) = 1·90, (obs.) = 1·88 ; space group $= C^5_{3v} - R3m$. From a consideration of the intensities the interatomic distances in the OCN group are obtained and the configuration of the atoms confirms the formula O = C = N —. J. I.

2678. Structure of Rubidium Dithionate. W. H. Barnes and A. V. Wendling. *Zeits. f. Krist.* 99. 2. *pp.* 153–180, 1938. *In English.*—A very careful redetermination of the unit cell (a 10·02, c 6·35 Å, containing 3 molecules, space group D^2_3), and parameters confirms previous results [see Abstract 4767 (1932)], save for slight alterations which bring into closer agreement the observed and calculated intensities. The ion $S_2O_6^{11}$ has the structure O_3–S–S–O_3, each O_3 forming the base of a triangular pyramid of which the S's are the apices. S–S = 2·08, S–O = 1·50, O–O = 2·51 Å. The relative positions of these and the Rb atoms are shown by a projection of the unit cell on the basal plane. C. A. S.

2679. Structure of Trisodium-Tricyanmelamine Trihydrate. J. L. Hoard. *Am. Chem. Soc., J.* 60. *pp.* 1194–1198, *May,* 1938.—It is deduced from X-ray data that trisodium-tricyanmelamine trihydrate possesses a hexagonal unit of structure with $a_0 = 10{\cdot}23$ Å, $c_0 = 5{\cdot}56$ Å, containing $2Na_3C_6N_9{\cdot}3H_2O$, space-group $D^4_{3h} - C\bar{6}2c$. The tricyanmelamine ions pack together with water molecules in symmetry planes to form atomic layers which are equally spaced perpendicular to the hexagonal axis. These negatively charged layers are bound together by Na ions each of which is octahedrally surrounded by four N and two O atoms at distances agreeing with the sums of the respective ionic radii. Packing relations within this structure and the stereochemistry of the anion are compared with the corresponding data for cyanuric triazide. The stabilities of both anion and crystal are reflected in the compact and generally satisfactory nature of the structure. AUTHOR.

2680. Structure of Bromo-Cupric Compounds. A. Silberstein. *Comptes Rendus,* 206. *pp.* 1490–1492, *May* 16, 1938.—Complex compounds having the general formula $CuBr_4$, $2A{\cdot}(NH_4)_2$, (A = amine), have been investigated by X-ray crystal analysis. In an earlier paper [*ibid.* 205. *p.* 909, 1937] the author gave details of the crystal analysis of compounds where A = pyridine, aniline and *p*-toluidine. In the present paper results are given for compounds in which A = *o*- and *m*-toluidine. For the *o*-compound $a = 7{\cdot}88$ Å, $c = 17{\cdot}43$ Å and for the *m*-compound, $a = 7{\cdot}88$ Å, $c = 17{\cdot}64$ Å. A new interpretation is given of the results for $CuBr_4{\cdot}2NH_3(NH_4)_2$ and it is now shown that the Cu atoms are not in a regular arrangement in the lattice. J. I.

2681. Structure of Cyanuric Acid $(HCNO)_3$. E. H. Wiebenga and N. F. Moerman. *Zeits. f. Krist.* 99. 3. *pp.* 217–229, 1938.—The crystals are pseudo-orthorhombic with unit cell dimensions as follows, $a = 7{\cdot}90 \pm 0{\cdot}02$ Å, $b = 6{\cdot}74 \pm 0{\cdot}03$ Å, $c = 9{\cdot}04 \pm 0{\cdot}03$ Å, $\beta = 90°$, 4 mol. per unit cell, space group $= C^6_{2h} - C2/c$. The molecule is shown to consist of a regular plane hexagon with side 1·36 Å. The planes of the molecule are parallel to the (001) lattice planes. The question of resonance between the C-N bonds in the ring and the C-O bonds in the side chain is discussed. The intermolecular distances suggest that there are " hydrogen " bonds between a N-atom of one molecule and an O-atom of the neighbouring molecule. J. I.

2682. Crystallographic Investigations in Terpene Chemistry. G. Giacomello. *Zeits. f. Krist.* 99. 2. *pp.* 89–94, 1938.—It is established by an X-ray analysis that the hydrocarbon $C_{24}H_{18}$ obtained by selenium dehydrogenation of several terpenes is 1 : 8-dimethylpicene. The crystals are monoclinic with unit cell dimensions, etc., as follows, $a = 8{\cdot}16 \pm 0{\cdot}02$ Å, $b = 6{\cdot}36 \pm 0{\cdot}02$ Å, $c\sin\beta = 11{\cdot}92 \pm 0{\cdot}04$ Å, $\beta = 84°$; density $= 1{\cdot}316 \pm 0{\cdot}003$gr./cc.; space group $= P2_1$. Patterson syntheses are made on (001), (010) and (100) from which it is possible to construct a model of the unit cell showing the arrangement of the molecules with respect to the cell axes. J. I.

2683. Polymorphic Forms of Long-Chain Hydrocarbons. T. Schoon. *Zeits. f. phys. Chem.* 139. *Abt.B.* 5–6. *pp.* 385–410, 1938.—By means of a combination of electron and X-ray diffraction methods the structures of the following compounds are obtained, 2 modifications of the paraffin $C_{30}H_{62}$, paraffin $C_{31}H_{64}$, stearic acid, margaric acid, palmitic acid, cetyl alcohol, cetyl palmitate, dicetyl ether, tetradecane dicarboxylic acid, and sebacic acid. A comparison of the results obtained and of those already published for compounds of the above type shows that their unit cell dimensions fall into a few classes, each class being characterised by particular values of a, b and β. These classes can be looked upon as possible polymorphic modifications and the classification is helpful in determining the method of packing of the long chain molecules in a particular compound. J. I.

2684. Theory of Liquids. A. Ganguli. *Indian Journ. Phys.* 12. *pp.* 25–33, *March*, 1938.—A general form of distribution function of molecules is given and special cases for gases, liquids and solids are considered. The consequences of the different terms in the potential energy as given by London [see Abstract 1420 (1937)] are considered and a qualitative explanation of rotation in liquids and solids, viscosity, polymerisation, formation of glass, secondary structure, etc., is offered. While some liquids having symmetrical molecules, have the same grouping or clustering of molecules as in solids, others have varying coordination number. Certain simplified expressions for distribution function, cohesion, internal forces, viscosity, etc., are reviewed. Van der Waals' equation is discussed at length and cohesive forces and viscosity are calculated therefrom. Some relations for viscosity, due to Guzman, Andrade and others, and time of relaxation are obtained in a simplified manner. AUTHOR.

2685. Internal Periodic Potential of Crystals. A. Hautot and J. J. Trillat. *J. de Physique et le Radium*, 9. *pp.* 133–139, *April*, 1938.—The principle is described of a method of measuring the $V_{\alpha\beta\gamma}$ terms in the development, as a Fourier series, of the internal periodic potential of cubic crystals and also of an attempt to realise the method experimentally. Measurements are made for Ni, Au, Cu_2O, and graphite, but the values obtained do not agree with the theory of reflection of an electronic wave by a crystal, and modifications of the theory are examined. N. M. B.

See also Abstracts 2654, 2665, 2695, 2846, 2940, 2953, 3001, 3018, 3019, 3021.

DENSITY.

***2686. Determination of the Vapour Densities of Indigo and Other Organic Compounds by means of a Spoon Gauge. C. E. Dent and R. P. Linstead.** *Chem. Soc., J. pp.* 715–717, *May*, 1938.—The application of the spoon gauge to the determination of the molecular weights of volatile organic compounds is described. The molecular weights of indigo, phthalimide, and of the polymeride of phthalonitrile are recorded. AUTHORS.

2687. Density of Aqueous Solutions of HCl. G. Åkerlöf and J. Teare. *Am. Chem. Soc., J.* 60. *pp.* 1226–1228, *May,* 1938.—The density of HCl solutions has been determined at a number of concentrations from 0 to 80°. From the experimental data equations have been derived for a calculation of the density at arbitrary concentrations and temperatures. The equations were used to compute a table of densities for solutions containing 0 to 38 wt.% HCl in the temperature range 0 to 80°. AUTHORS.

See also Abstract 2663.

DIFFUSION AND OSMOSIS.

2688. Solution of the General Problem of the Theory of Diffusion. B. Hostinský. *Comptes Rendus,* 206. *pp.* 1452–1455, *May* 16, 1938.—A general mathematical expression is obtained for the flow of grains in a rectilinear tube filled with water. R. S. R.

2689. Temperature Variation of Diffusion Processes. H. S. Taylor. *J. Chem. Phys.* 6. *pp.* 331–334, *June,* 1938.—The Eyring concept of holes in liquids and his theory of absolute reaction rates indicate that diffusion coefficients should vary exponentially with temperature. Data in the literature indicate that this is true. It is shown that empirical observations concerning the relation between diffusion velocity and its temperature coefficient, hitherto generally assumed to be linear, are readily explained upon the basis of holes in liquids as a controlling factor. As with viscosity, in liquids containing hydrogen bonds relatively high activation energies of diffusion are found. Data for small diffusing molecules should not show a constant diffusion-viscosity product as required by the Stokes-Einstein relation at constant temperature, but a product varying within restricted ranges with the dimensions of the solvent molecules. Data already available tend to confirm this conclusion. AUTHOR.

2690. Determination of Spontaneous Diffusion in Solid Hydrogen from the Reaction Course of the Ortho-Para Transformation. E. Cremer. *Zeits. f. phys. Chem.* 39. *Abt.B.* 5–6. *pp.* 445–464, 1938.—The transformation of *o*-H_2 into the *p*-form in the solid state is one of the second order, and the reaction remains incomplete because single *o*-molecules can be isolated. In the present paper, that particular concentration R is evaluated for which a bimolecular reaction in the solid phase must come to a standstill if no change of position of the molecules takes place. From this residual concentration R, the concentration-time curve for the expiration of the reaction has been calculated for the cases when the molecules do and do not change positions. The spontaneous diffusion coefficients in solid H_2 are found to be as follows: $D_{11\cdot3^\circ} \ll 1\cdot5\cdot10^{-17}$, $D_{11\cdot8^\circ} = (3 \pm 3)\cdot10^{-17}$, $D_{13\cdot2^\circ} = (1 \pm 0\cdot2)\cdot10^{-15}$, $D_{13\cdot6^\circ} \gg 1\cdot7\cdot10^{-15}$ cm²./day. A standard curve is given for the determination of *o*-H_2 by the thermal conductivity method at average pressures (50 mm. Hg). The velocity constants of the *o*–*p*-H_2 transformation in liquid and solid phase, have now been more accurately determined and the following data obtained: At 11° to 12° Abs. k solid $= (17\cdot5 \pm 0\cdot2) \times 10^{-5}$, at 20° Abs. k liquid $= (11\cdot2 \pm 0\cdot1) \times 10^{-5}$ (1% content-hours). The minimum value for the density at 12° Abs. is calculated to be $\gg 0\cdot084$. H. H. Ho.

2691. Osmotic Pressure, Heat and Entropy of Dilution in the Systems Nitrocellulose-Cyclohexanone and Nitrocellulose-Acetone. C. G. Boissonnas and K. H. Meyer. *Zeits. f. phys. Chem.* 40. *Abt.B.* 1–2. *pp.* 108–114, 1938.—The equation for the calculation of the entropy of dilution and of the heat of dilution is derived from the temperature dependence of the osmotic pressure, and it is shown which parts may be ordinarily neglected. Experimental data in connection with the entropies and heats of dilution of the system nitrocellulose-cyclohexanone are included. It is shown that the data given by G. V. Schulz for the entropies and heats of dilution of the system nitrocellulose-acetone are invalid in consequence of a computation error, and that doubt arises as to the reliability of these measurements. H. H. Ho.

See also Abstracts 2659, 2668.

ELASTICITY AND PLASTICITY.

2692. Equilibrium of Membranes. H. Pailloux. *Comptes Rendus*, 206. *pp.* 1445–1446, *May* 16, 1938.—Expressions are derived giving the tensions throughout the surface of a membrane in equilibrium under the action of forces which are not external to the contour of the membrane. It is thence shown that in the case of such a membrane the tensions define a possible rotation of an inextensible surface coinciding with the equilibrium position of the membrane. Conversely, the distribution of tensions can be derived from a knowledge of all the possible rotations of the surface. The expressions are applied to deduce the conditions requisite in order that for every section of the membrane (whether inextensible or not) the tension may be normal. J. S. G. T.

2693. New Forms of the Theorem of Three Moments. F. J. Turton. *Phil. Mag.* 25. *pp.* 852–864, *June*, 1938. *Supplement.*—The formula for the relation between the bending moments at three consecutive supports of a loaded beam is generalised to take into account concentrated loads, additional moments applied at points within the bays, and distributed loads varying in any manner, the contribution due to the last mentioned being expressed in the form of integrals taken over the bays. In the later sections the effect of thrust is also taken into account. The corresponding formulæ for the reactions at the supports are given in each case. W. G. B.

2694. Elastic Properties of Sodium Wires Between − 183° and 90° C. R. H. V. M. Dawton. *Phys. Soc., Proc.* 50. *pp.* 483–493; *Disc.*, 493–495, *July* 1, 1938.—The elastic properties of single-crystal wires and of polycrystalline sodium are investigated. The results obtained with single crystals are found to be in good agreement with a theory recently given by Fuchs [see Abstract 4993 (1936)]. The characteristic temperature θ is calculated from the data obtained with the polycrystalline material. A comparison is made with the author's recent X-ray measurements. AUTHOR.

2695. Atomic Foundation of Plasticity of Crystals. A. Kochendörfer. *Zeits. f. Metallkunde*, 30. *pp.* 174–178, *May*, 1938.—Experimental investigation has shown that in the plastic deformation of a single crystal the applied pressure σ contained a measurable factor $\Delta\sigma$ which depended upon the velocity of slip(u). The relationship is given by the equation $\Delta\sigma = \phi(u)$. When this quantity is subtracted from the measured applied pressure, the true hardening (*Verfestigung*) τ is obtained. The relationship $\tau = \sigma - \phi(u)$ is fulfilled. The experimental progress of the true hardening cannot be explained by a recovery which is only operative for the time of its action. F. J. B.

2696. Characteristic Oscillations of Spherical Shells. Part II. K. Federhofer. *Akad. Wiss. Wien, Ber.* 146. 2*a*. 7–8. *pp.* 505–514, 1937.

In Part I [see Abstract 5205 (1937)] differential equations and oscillation frequencies were obtained mathematically for vibrations under rotational symmetry due to bending and extension of spherical shells. In this case the treatment is extended to obtain differential equations under non-rotational symmetry and spherical harmonics are again used. Haver's method is expanded to give differential equations which, however, involve laborious calculation when applied to a special case. H. M. B.

2697. Non-Homogeneous Strings with Parabolic Density Distribution. A. Erdélyi. *Akad. Wiss. Wien, Ber.* 146. 2*a*. 9–10. *pp.* 589–604, 1937.—Reference is made to the results obtained by Karas [see Abstract 5206 (1937)] for the real frequency of non-homogeneous strings with the mass distribution a quadratic function of the length of the string. It is shown that for the general case the integration of the differential equation for non-homogeneous strings with indicated density distribution can be performed by using the Whittaker function $M_{k,m}(z)$. These functions are connected in a known way with that for a parabolic cylinder. The frequency equation is obtained approximately by asymptotic representation of the Whittaker functions and asymptotic expressions are obtained for the real frequency. The agreement with Karas' values is good. An approximate formula shows the kind of dependence of the real frequency on the parameters of the system. R. S. R.

2698. Rearrangement of Characteristic Frequencies and Damping in Coupled Oscillations. K. W. Wagner. *Ann. d. Physik*, 32. 3. *pp.* 301–312, *June*, 1938.—Commenting on the paper of G. Schmerwitz [see Abstract 4906 (1937)], the author points out that in 1935 he had dealt with all cases of coupled vibrations including coupling due to pure damping. He here sets out his reasoning and conclusions, considering various conditions and, in each case, laying particular stress on the effect of pure resistance coupling. Cases are examined where the original vibrations are in tune, but differently damped; where they are very much mistuned, but equally damped, and many intermediate conditions. The changes in frequency and damping are seen to change from case to case. Under some conditions no critical frequency is reached and the contrast between loose and tight coupling is very marked. The effect of energy coupling is compared with that of damping coupling, and the analogy between mechanical and electrical vibrations pointed out. H. M. B.

See also Abstracts 2730, 2790, 2958, 2960.

GRAVITATION.

See Abstract 2789.

HYDRODYNAMICS AND AERODYNAMICS.

2699. Distribution of Laminar Skin Friction on a Sphere Placed in a Uniform Stream. S. Tomotika and I. Imai. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 288–303, *April*, 1938. *In English.*—The momentum integral equation for the boundary layer on the surface of a body of revolution is applied to the case of the laminar boundary layer of a sphere placed in a uniform stream. The quartic form is assumed for the velocity distribution in the layer, and for the velocity distribution just outside the boundary layer, use is made of an actual distribution which has been obtained from the pressure distribution measured by Fage in a case when the Reynolds number of the stream was just within the critical range so that, according to Fage, the flow in the boundary layer was laminar up to the

point of separation. The differential equation for determining the thickness of the laminar boundary layer is solved by the method of graphical integration, and thus various characteristic quantities for the layer are calculated. It is found that the calculated point of separation is in good accordance with Fage's observation, and that the agreement between the calculated distribution of laminar skin friction and the observation is also quite satisfactory. Further, some discussions are made on small deviations which have been found near the point of minimum pressure between the calculated distribution of laminar skin friction and the observed points.
AUTHORS.

2700. Turbulent Velocity Distribution. J. J. Sommer. *Phys. Zeits.* **39.** *pp.* **454–460,** *June* **1, 1938.**—The velocity distribution was measured across a section of a circular pipe at several values of the static pressure. The section at which measurements were taken was in the middle of a straight portion 2·10 m. long, joined by two semi-circular bends of radius 30 cm. to a section containing an oil pump. The Reynolds numbers of the measurements are not given : the diameter of the pipe was 48 mm., and the maximum velocity was kept constant at about 90 cm./sec. Graphs of the velocity distribution are given for pressures of 760, 450, 150 mm. of mercury, and a "boundary layer thickness" δ (which as defined by the author is the maximum velocity divided by the velocity gradient at the wall) is plotted against the pressure p. The experimental accuracy is insufficient to distinguish whether the results agree better with a theoretical formula given by the author [see Abstract 1432 (1938)] or with $\delta \propto p^{-1/2}$.
S. G.

***2701. Venturi Measurements. L. Ferroglio.** *Ricerca Scientifica,* **9.** *pp.* **319–325,** *April,* **1938.**—The paper is a preliminary note on experiments intended to investigate the possibility of standardising measurements of fluid flow by Venturi-type meters.
W. A. R.

***2702. Measurements with a Half-Pitot Tube. G. I. Taylor.** *Roy. Soc., Proc.* **166A.** *pp.* **476–481,** *June* **16, 1938.**—The author suggested, in a discussion of Stanton's measurements of the surface friction of a fluid flowing past a smooth surface, made by using a so-called half-pitot tube [see Abstract 14 (1921)], that the limiting pressure (p_1) in a very small half-pitot tube is likely to tend to a limiting value as the opening, d, of the pitot tends to zero. The limiting pressure, p_1, for very small values of Reynolds number is given by $p_1 = K\mu a$, μ denoting the viscosity and a the rate of shear of the fluid at the half-pitot tube. By experiments with glycerine contained in the annular space between two coaxial cylinders of respective diameters 2 and 3 in., the inner being rotated at constant speed, it is shown, that the constant K has the value 1·2. Values of the "effective" (d') and actual (d) openings of the half-pitot are tabulated. The ratio d'/d ranges from 2·20 to 0·564 as d increases from 0·0254 mm. to 0·3556 mm.
J. S. G. T.

See also Abstracts 2658, 2666.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

2703. Numerical Solution of Laplace's Equation. G. H. Shortley and R. Weller. *J. of Applied Physics,* **9.** *pp.* **334–347,** *May,* **1938.**—This paper considers in detail numerical methods of solving Laplace's equation in an arbitrary two-dimensional region with given boundary values. The methods involve the solution of approximating difference equations by iterative procedures. Modifications of the standard Liebmann procedure are developed which lead to a great increase in the convenience and rapidity of obtaining such a numerical solution. These modifications involve the use of formulæ which simultaneously improve a block of points in place of a single point; methods of operating on the differences of trial functions in place of the functions themselves; and also a method of extrapolating to the final solution of the difference equations. The theory underlying these procedures is considered in detail by a new method which involves the expansion of the error and difference functions in terms of eigenfunctions. This permits definite comparison of rates of convergence of various procedures. The techniques of handling practical problems are considered in detail. AUTHORS.

2704. Law of Anomalous Numbers. F. Benford. *Am. Phil. Soc., Proc.* 78. 4. *pp.* 551–572, 1938.—It is found that if numbers of four or more digits taken from data relating to widely different subjects are statistically examined, the frequency distribution of the first digits is logarithmic. The fact that such numbers (which are individually without relationship) are, when considered in large groups, in good agreement with a distribution law has given rise to the term "anomalous numbers." There is also a tendency for bodies of numerical data to fall into geometrical series. An equation is given showing the frequencies of first digits in the different orders of numbers 1 to 10, 10 to 100, etc., and also the frequency of digits in the second, third, etc., place of a multi-digits number. Examples showing that geometric and logarithmic series are common in human affairs are given which leads to the conclusion that the law of anomalous numbers is a probability law of widespread application. A. M. T.

2705. Electromagnetic Units. F. Hund. *Phys. Zeits.* 39. *pp.* 376–379, *May* 1, 1938.—The electromagnetic units are given in two tables, one in which the units are based on fundamental equations containing 4π and the other on equations which do not contain 4π. The Gaussian, absolute, practical and atomic systems are compared and the nomenclature is given. H. J. H. S.

2706. M.K.S. System of Units. *Am. Phys. Teacher*, 6. *pp.* 144–151, *June*, 1938.—A Report of the Committee of the American Association of Physics Teachers on Electric and Magnetic Units.

See also Abstracts 2748, 2927, 2997.

MECHANICS, CLASSICAL.

2707. Unequal Moments of Inertia of Slabs. V. A. Nicolsky. *Comptes Rendus*, 206. *pp.* 1364–1365, *May* 9, 1938.—A method is developed by which the calculation for a slab with unequal moments of inertia can be related to that in which the moment of inertia is constant, and is confirmed in the case of a rectangular slab by comparison with the direct solution. **Errata,** *ibid. p.* 1600, *May* 23, 1938. N. M. B.

2708. Trembling Movements. H. Diesselhorst. *Ann. d. Physik*, 32. 1–2. *pp.* 205–210, *May*, 1938.—A qualitative description is given of the superposition of h.f. oscillations on a small pendulum, by vertical motions of the centre of gravity. Experimental examples include a short wire pendulum attached to one prong of a tuning fork. If a mass is moving, under damping proportional to velocity, in a constant field of force with an oscillating field superposed, it is shown mathematically that the mass tends to move out of the field. H. M. B.

MECHANICS, QUANTUM.

2709. Theory of " Spiral " Orbits of the Electron in a Coulomb Field. J. Frenkel and J. Rojansky. *Phys. Zeits. d. Sowjetunion,* 13. 2. *pp.* 181–197, 1938. *In English.*—According to the classical relativity theory the motion of an electron with an angular momentum smaller than $p_0 = Ze^2/c$ in a Coulomb field proceeds along spiral orbits, which may extend to infinity (Sommerfeld) or to a finite distance, being a modification of the ordinary rosette-type of motion. It turns out that in the latter case the period of the motion (from aphelion to aphelion) remains finite, although the motion cannot be quantised even if $Z > 137$ because the radial integral of the Sommerfeld theory diverges. Equivalent results are shown to hold in the relativistic quantum theory based on Dirac's equation for the motion of an electron about a nuclear charge larger than 137. Several cases: $w > m_0c^2$, $0 < w < m_0c^2$, $-m_0c^2 < w < 0$ and $w < -m_0c^2$, where w is the total energy of the electron, are investigated. In conclusion the bearing of the theory upon the problem of the natural limitation of the atomic number Z is briefly discussed. AUTHORS.

2710. Interaction Energy in Electrodynamics and in the Field-Theory of Nuclear Forces. E. C. G. Stueckelberg. *Helv. Phys. Acta,* 11. 3. *pp.* 225–244, 1938. *In German.*—It is proved that the quantum theory of wave-fields leads to the same expression for the interaction between two charges as does the classical theory of retarded potentials. The form of the interaction operator is worked out, a complete discussion being given for the case of a scalar field. G. C. McV.

2711. Principles of the Quantum Theory. F. Jüttner. *Zeits. f. Physik,* 109. 1–2. *pp.* 139–146, 1938.—A discussion of the fundamental conceptions of classical and quantum physics, and the differences between them, is followed by an attempt to clarify the conceptions of quantum physics by the introduction of new names for physical realities by the addition of the prefix " hemi," equivalent to " half," before the word when applied to the concept in the quantum theory: for example, wave becomes hemiwave, and law hemilaw. Similarly another word " korporundal " is coined to express a concept which obeys both particle and wave laws: the elementary particles of physics, the electron and the photon, are thus korporundal. Quantum physics is thus a korporundal-theory and so on. It is hoped by this means to give a logically clear sketch of the basic principles of the quantum theory. G. O. B.

2712. Quantum Theory and the Atomic Nucleus. N. Bohr. *Ann. d. Physik,* 32. 1–2. *pp.* 5–19, *May,* 1938.—Report on the development of the quantum theory of the nucleus. R. P.

2713. Universal Length in the Theory of Elementary Particles. W. Heisenberg. *Ann. d. Physik,* 32. 1–2. *pp.* 20–33, *May,* 1938.—A discussion of the difficulties of present-day quantum theory suggests an analogy with the difficulties of earlier theories which necessitated the introduction of relativity and the quantum. Whereas the latter two theories are characterised by the universal constants c and h, it seems probable that a future theory will have to contain a constant of the dimensions of a length, and probably of the order of the classical electron radius r_0. Some features of such a theory are discussed, and it is shown, in particular, that in this theory very fast particles, of energies exceeding the value hc/r_0, would be able to produce " bursts " of many new particles in a single collision with an atom. Such " bursts " (as distinguished from ordinary cascade showers) have apparently been observed in cosmic-ray photographs. R. P.

2714. Ambiguity of the Wave Function. E. Schrödinger. *Ann. d. Physik*, 32. 1–2. *pp*. 49–55, *May*, 1938.—The conception has been established that in wave mechanics for each given problem, one has to admit in a given representation either only plain wave functions, or two-fold functions whose two branches are distinguished only by sign. The admission of the first class excludes the admission of the other and *vice versa*. G. O. B.

2715. Artificial Limiting Conditions in the Kepler Problem. A. Sommerfeld and H. Welker. *Ann. d. Physik*, 32. 1–2. *pp*. 56–65, *May*, 1938.—Instead of treating the problem of the ground state of the H atom with the natural boundary conditions of Schrödinger, the author treats it with the artificial boundary conditions $\psi = 0$ for $r = r_0$. These conditions can be thought of as being produced by an infinitely high and infinitely steep potential wall situated at the position $r = r_0$. The eigenfunction will be given by a convergent continuous hypergeometric series. The energy will be represented as a function of r_0. The electron is bound in the nucleus ($W < O$) for $r_0 > 1\cdot835\,a$ (a is the radius of the H atom) while for $r_0 < 1\cdot835\,a$ the binding of the nucleus is compensated by the effect of the potential wall ($W > O$). In the neighbourhood of $W = O$ the eigenfunction and the eigenvalue are given approximately by Bessel functions. G. O. B.

2716. Dirac Magnet Pole. P. Jordan. *Ann. d. Physik*, 32. 1–2. *pp*. 66–70, *May*, 1938.—In a discussion of some of the consequences of the Dirac magnet pole, use is made of the system of nodal lines postulated by Dirac. These nodal lines start at a positive pole and end at a negative pole or at infinity. Since these lines are merely accessory to the construction to be described, it is evident that any physical statement of the theory must be independent of the special choice of these nodal lines, which fact is demonstrated in the paper. G. O. B.

2717. Mean Distribution of Electrons in a Complex Atom. A. Datzeff. *Comptes Rendus*, 206. *pp*. 1359–1361, *May* 9, 1938.—A mathematical investigation of the distribution of electrons is developed by the method of potential barriers [see Abstract 1540 (1937).] N. M. B.

2718. Self-Consistent Field with Exchange for Potassium and Argon. D. R. Hartree and W. Hartree. *Roy. Soc., Proc.* 166*A*. *pp*. 450–464, *June* 16, 1938.—The differences between the atomic wave funtions calculated by the method of the self-consistent field with and without exchange can in certain cases be plotted in such a way that the results for different atoms fall on approximately the same curve, which then can be used for interpolating between different atoms. Wave functions so estimated, using the results already calculated for Cl^- and Ca^{++}, have been used as the basis of calculations of the self-consistent field for K^+ and A. For K^+ all the (nl) wave functions have been calculated; the results showed that for A all but the outer [($3s$) and ($3p$)] wave functions could be interpolated to adequate accuracy by the method mentioned. Results are given, and values of the diamagnetic susceptibilities calculated and compared with observed values. AUTHORS.

2719. Statistical Mechanics of Condensing Systems. M. Born and K. Fuchs. *Roy. Soc., Proc.* 166*A*. *pp*. 391–414, *June* 3, 1938.—Extensive reference is made to papers by J. E. Mayer and his collaborators under the same title [see Abstract 979 (1938)] the purpose being to clarify, substantiate and somewhat extend Mayer's mathematical treatment. It is shown that the exact evaluation of the partition function for a system of equal particles exerting central forces leads to the complete thermodynamics of a gas, including the phenomenon of condensation. By making the assumption that the coefficients of the partition function, the irreducible integrals β_ν, do not depend on volume, the theory explains condensation and indicates the possibility of the existence of different condensed phases.

R. W. P.

See also Abstracts 2649, 2723, 2823, 2887, 2916, 2916, 2948, 2997, 3000.

PHILOSOPHY OF SCIENTIFIC METHOD.

2720. Pragmatic and Dogmatic Spirit in Physics. J. Stark. *Nature*, 141. *pp.* 770–772, *April* 30, 1938.—The spirit or mental attitude of physicists engaged in fundamental research is in the main either pragmatic or dogmatic. The pragmatic spirit is directed towards reality, the basis of the approach being by formation of conceptions by the inductive method, followed by experimental confirmation based on deduction, or unhesitating rejection when the deduction is not confirmed. The work of Rutherford and Lenard exemplified this. In contrast to this the mathematical and theoretical physicists such as Einstein, Born, Jordan, Heisenberg, Sommerfeld and Schrödinger are of the dogmatic school. Starting out from *a priori* conceptions or arbitrary definitions they obtain by logical and mathematical operations formulæ which they then seek to interpret physically. The pragmatic spirit advances continuously to new discoveries whereas the dogmatic attitude leads to the crippling of experimental research. It is noteworthy that the dogmatist appears to attract and gain publicity by propaganda in contrast to the pragmatic worker who is content to let results speak for themselves. It appears that the Jewish mind is more prone to the dogmatic attitude than the Nordic type. The author however seeks to combat the dogmatic spirit wherever it occurs.

A. M. T.

PRESSURE.

***2721. Extreme Pressures and their Importance in the Investigation of Engineering Problems. T. C. Poulter.** *J. of Applied Physics*, 9. *pp.* 307–311, *May*, 1938.—Work carried out in the high pressure laboratory of the Research Foundation of Armour Institute of Technology is briefly surveyed. The action of H_2SO_4 on Zn has been studied at pressures up to 30,000 atm. ; H_2 is found to react with H_2SO_4 to give H_2S and water. The rate of hydrolysis of sucrose decreases with increase of pressure. Pressure apparatus with glass, quartz or diamond windows capable of withstanding pressures up to 500,000 lb./in^2. has been erected. The intensity of phosphorescence of ZnS decreases to one-half at a pressure of 30,000 atm. The Lorenz-Lorentz relation between refraction index and pressure is found to be true for the substances investigated. 12000 atm. is required to kill bacteria. Colloidal $Fe(OH)_3$ is completely precipitated at 100 atm., while molybdenum blue is only slightly precipitated at 17,000 atm. The viscosity of many lubricating oils is increased 200,000,000 times under high pressures. Various other matters of physical, chemical and engineering are very briefly referred to. The highest pressure hitherto produced at the Institute is 1,500,000 lb./in^2.

J. S. G. T.

*2722. **Sensitive Manostat for Low Gas Pressures. T. Soller, S. Goldwasser and R. A. Beebe.** *Am. Chem. Soc., J.* 60. *pp.* 1265–1266, *May*, 1938.—A correction [see Abstract 4930 (1936).]

RELATIVITY AND ETHER.

2723. **New Equations of Motion of Material Systems in a Minkowski World. J. Lubański.** *Acta Physica Polonica*, 6. 4. *pp.* 356–370, 1937. *In German.*—The equations of motion of a material system, derived by Mathisson from the general theory of relativity [see Abstract 969 (1938)], are here derived for the case of a material system in a Minkowski world by the method of retarded potentials. A physical interpretation of the theory is discussed. J. S. G. T.

2724. **Problem of *n* Bodies in General Relativity Theory. A. S. Eddington and G. L. Clark.** *Roy. Soc., Proc.* 166*A*. *pp.* 465–475, *June* 16, 1938.—Levi-Civita has discussed the problem of two bodies in general relativity theory and has concluded that the centre of gravity has a secular acceleration in the direction of the major axis of the orbit towards the periastron of the larger mass. The authors show that there is *no* secular acceleration of the centre of gravity. It is suggested that Levi-Civita's positive result may be attributable to a numerical slip in the coefficient of one of the terms, the authors' null result being due to the mutual cancelling of a number of terms. An error in the calculation of one of the terms in de Sitter's general formula for the line element due to n bodies is referred to. The error arises owing to de Sitter taking $\int \rho dV$ as the mass instead of the correct expression $(g_{11}g_{22}g_{33})^{1/2}\int \rho dV$. The mass, M, of a system of n bodies is shown to be equal to $E+(1/2)d^2C/dt^2$ where E denotes the whole energy of the bodies, and C is the moment of inertia of the system about its centre of mass; the term $(1/2)d^2C/dt^2$ appears to be new. The theory of the equivalent mass of a system of particles comes into line with the theory of the equivalent mass of continuous matter developed by Tolman, Whittaker and others.

J. S. G. T.

2725. **Unified Field Theories. W. E. Kock.** *Current Science*, 6. *pp.* 546–548, *May*, 1938.—Weyl's, Kaluza's, Klein's, Einstein's, and Veblen and Hoffmann's unified field theories are briefly reviewed.

J. S. G. T.

2726. **Electromagnetic and Gravitational Radiation. L. Infeld.** *Phys. Rev.* 53. *pp.* 836–841, *May* 15, 1938.—Guided by the analogy of the electromagnetic field the influence of gravitational radiation on the gravitational field and on the equations of motion in the case of a two-body problem are considered. This leads to a generalisation of the previously developed methods of solving the gravitational equations and finding the equations of motion. AUTHOR.

2727. **Mathematical Theory of a New Relativity.—Rotational Theory of Light and Matter. S. M. Sulaiman.** *Nat. Acad. Sci. India, Proc.* 7. 2–3. *pp.* 65–87, 1937.—Maxwell's equations have solutions corresponding to rotating electromagnetic waves. The present author identifies them with his "light corpuscles" which consist of two equal and opposite charges of equal mass rotating about their centre of gravity, the whole system moving forward with the velocity of

V.4
193

light. A similar type of system can be made to correspond to a H atom. [See Abstract 3419 (1937).] G. C. McV.

See also Abstracts 2649, 2752, 3026.

SOLUTION.

2728. Energy Relationships in Aqueous Solutions of Noble Gases. E. Lange and R. Watzel. *Zeits. f. phys. Chem.* 182. *Abt.A.* 1. *pp.* 1–17, 1938.—Energies of hydration (defined as $-RT\ln\alpha'$, where α' is the Ostwald solubility coefficient) are deduced for the system noble gas–water for He, Ne, A, Kr, Xe and Em. In order to obtain the pure energy of interaction between solute and solvent, the energy of separation of the water molecules to make space for the solute is estimated. The energies of interaction between the noble gases and water are found to be of the same order as for chemical combination (*e.g.*, for Em, 30 kg.cal.). L. A. W.

2729. Theory of Two-Component Systems Involving Solution Forces. K. Fredenhagen. *Zeits. f. phys. Chem.* 40. *Abt.B.* 1–2. *pp.* 51–107, 1938.—The author derives the fundamentals of a general theory of two component systems over the whole range of binary mixtures. The new theory is based on the van't Hoff vapour pressure–osmotic pressure conceptions and on the Planck thermo-dynamical considerations. The binary mixtures of perfect gases are first investigated and in the application of the results to liquid mixtures the conclusions and procedure of van't Hoff and Planck are critically discussed. The problems of intermolecular forces are then investigated and the necessary modifications to the classical formulæ introduced. It is also shown that during the fusion of binary mixtures of inorganic and organic compounds and of binary metallic alloys numerous systems arise which can only be explained by the occurrence of chemical reactions. These complications are dealt with in various simplified cases of component distribution. H. H. Ho.

2730. Compressibility and Solvation of Solutions of Electrolytes. A. Passynski. *Acta Physicochimica,* 8. 4. *pp.* 385–418, 1938. *In English.*—A theory is elaborated, which determines the solvation of electrolytes in terms of the compressibility of solutions and is based upon Debye's theory of the compressibility of electrolyte solutions as well as upon Bridgman's experiments. A method is devised for determining the compressibility of electrolyte solutions by observing the velocity of propagation of ultrasonic waves in them, using the Pierce acoustic interferometer. The compressibility of solutions of LiCl, LiBr, NaF, NaCl, NaBr, NaI, KF, KCl, KBr, KI, $BeCl_2$, $MgCl_2$, $BaCl_2$ and $AlCl_3$ was measured over a wide range of concentrations. It is shown that the compressibility change in solutions of electrolytes is proportional to the number of ions in solution and to the 1·5-th power of their charge, and depends but little upon their radii; the result sobtained are confronted with the conclusions of Debye's theory. The solvation of the electrolytes investigated has been calculated from the author's own data on the compressibility of electrolytes as well as by recalculating some data borrowed from the literature. The results obtained are discussed from the standpoint of Bernall and Fowler's theory of the hydration of ions and applied to computing the solvation of individual ions. AUTHOR.

See also Abstracts 2663, 2840.

SURFACE PROPERTIES.

2731. Adsorption of Vapours at Plane Surfaces of Mica. Part II. D. H. Bangham and S. Mosallam. *Roy. Soc., Proc.* 166*A*. *pp*. 558–571, *June* 16, 1938.—The results are given of measurements of the quantities of benzene, methyl alcohol, and CCl_4 adsorbed at a known surface area of mica at pressures approaching saturation. The adsorption energy per mol. is constant whilst the first molecular layer is being formed (benzene, methyl alcohol), but its completion is marked by an abrupt decrease to a value near the normal heat of liquefaction. The graphs of apparent film thickness against relative pressure for the three substances are not widely divergent over much of the range investigated, but the isotherms show discontinuities or sharp changes of curvature at adsorption values which depend on the specific properties of the molecules, and are thought to be related to molecular spacings in the bulk condensed phases. Approximate values are given for the surface tension lowering of the mica, caused by the saturated vapours. [For Part I see Abstract 1858 (1938).] AUTHORS.

2732. Chemisorption on Charcoal. H. H. Chambers and A. King. *Chem. Soc., J. pp*. 688–692, *May*, 1938.—The influence of temperature of activation on the hydrolytic and molecular adsorption of salts by pure sugar charcoal has been studied. Curves are given showing how adsorption per unit area varies with temperature of activation. These curves are continuous, and they show that the fundamental difference between high- and low-temperature charcoals is that the former liberate bases from salts whereas the latter liberate acids. Various factors affecting the shape of the curves are discussed, and it is pointed out that the surface oxide theory cannot give a detailed account of the mechanism of hydrolytic adsorption although it does account for the general trend of the results. The results for different salts are in agreement with observations of previous workers that salts of strong acids and weak bases or strong bases and weak acids are adsorbed both hydrolytically and molecularly, but salts of strong acids and strong bases are adsorbed only hydrolytically. [See Abstract 4751 (1937).] AUTHORS.

2733. Swelling of Charcoal. Part V. Saturation and Immersion Expansions and Heat of Wetting. D. H. Bangham and R. I. Razouk. *Roy. Soc., Proc.* 166*A*. *pp*. 572–586, *June* 16, 1938.—The percentage linear expansion x_s of a rod of inactive wood charcoal when exposed to the exactly saturated vapour of methyl alcohol is found to be less than the expansion x_L produced by immersion in the liquid. The expansion is proportional to the surface energy lowering of the charcoal, and this relation is confirmed by comparing $(x_L - \mathrm{T}dx_L/d\mathrm{T})$ with the measured heat of wetting. On immersion of the air-free charcoal the liquid wets all, or nearly all, of the adsorbing surface. From well-supported estimates, previously given, of the specific surface of the charcoal, it becomes possible to assign values to the free and total energy changes per cm^2. which accompany saturation and immersion. [For Part IV see Abstract 4769 (1934).] AUTHORS.

2734. Surface Tension of Aqueous Solutions. M. Dole. *Am. Chem. Soc., J.* 60. *pp*. 904–911, *April*, 1938.—A general equation for the surface tension of aqueous salt solutions is derived by making use of a modified form of the Langmuir hyperbolic adsorption equation, of a modified form of the Langmuir concept of a monolayer of pure water on the surface of salt solutions, and of a new hypothesis concerning the number of locations on the water surface available for adsorption of negative ions. The equation is capable of reproducing the results of Jones and Ray [see Abstract 3428 (1937)] whose tentative explanation is rejected. The equation reduces under appropriate conditions to the Szyszkowski equation for fatty acids, and under other conditions to an equation applicable to sucrose solutions. P. H. B.

2735. Surface Tension of Fused Mixtures having Cryolite as Base. E. Elchardus. *Comptes Rendus,* 206. *pp.* 1460–1462, *May* 16, 1938.—Mixtures of cryolite with different proportions of NaF, AlF_3 and Al_2O_3 are cooled at the rate of 5° per min. and the surface tension obtained from the pressure required to force bubbles of gas at the rate of 6 per min. through a capillary tube in the liquid. From the table it is seen that at 20° above the fusion point, the surface tension is decreased by increase of AlF_3, increased by addition of NaF, while no definite influence is shown for Al_2O_3. Since there is usually a large interval of solidification, measurements of surface tension can be made below the temperature at which solidification begins. Contrary to expectation, surface tension increases with temperature due to ionic dissociation. By calculation of the parachor, it is confirmed that in the liquid state, cryolite is no longer stable and has a formula $(AlF_6Na_3)^n$, where n is very probably 2. H. M. B.

2736. Surface Tension Anomalies of Paraffin Chain Salts. N. K. Adam and H. L. Shute. *Faraday Soc., Trans.* 34. *pp.* 758–765, *June,* 1938.—The fall in surface tension of dilute solutions of paraffin chain salts has been followed, for many days, by the sessile bubble method. An adaptation of the maximum bubble pressure method, whereby the changes in tension during the first few minutes of the life of a surface can be ascertained, is also described. Very dilute solutions fall slowly in tension for a week or longer, ultimately reaching, however, very nearly the same tension as stronger solutions. There is a critical concentration, of the order $N/1000$ when the hydrocarbon chain contains 16 C atoms, and $N/100$ when it is 12 C atoms long, above which the final surface tension is reached almost at once. These concentrations are nearly the same as those at which the ionic micelles commence to be formed in the solutions. Salts tend to reduce the concentration at which the final tension is rapidly reached, without, however, much altering this final tension. AUTHORS.

2737. Structure of Electrolytic Deposits. P. Jacquet. *Rev. de Mét.* 35. *pp.* 41–51, *Feb.*; 116–130, *March and pp.* 176–187, *April,* 1938.—A connected account of the author's work [see Abstracts 1309 (1934), 1844 (1936), 2793 and 3719 (1937)] with the relevant work of others on electrolytic polishing of metals and change in surface structure caused thereby, also on the structure of the layer of metal deposited electrolytically on such a surface under varying conditions as to composition of solution, c.d., voltage, etc., with special reference to crystal continuity. Deposition of Cu is chiefly considered, but with some reference to that of Ag, Cd and Ni. C. A. S.

2738. Molecular Interaction in Monolayers. J. Marsden and J. H. Schulman. *Faraday Soc., Trans.* 34. *pp.* 748–758, *June,* 1938.—A study of equimolecular mixed monolayers of molecules consisting of different polar groups and similar chain length on substrates of different pH has been made by the surface potential and pressure methods; the components being cetyl alcohol, octadecyl methyl ether, stearic acid and octadecyl amine. The changes in surface potential and surface pressure which take place on mixing are attributed to changes in electrical forces between the polar groups. Coulomb attractive forces acting between the polar groups of a two-component monolayer may be divided into three classes in order of decreasing magnitude depending on the nature of the polar groups ; (1) ion-ion of opposite sign, (2) ion-dipole and (3) dipole-dipole ; repulsive forces occurring in a system composed of ions of like sign. The state (solid condensed, liquid condensed, vapour expanded) of one component monolayers, containing molecules with an ionisable polar group, on substrates of different H-ion concentration depends on the degree of ionisation of the polar groups and the subsequent electrical forces acting between these polar groups. AUTHORS.

2739. Overturning and Anchoring of Monolayers. I. Langmuir. *Science*, 87. *pp.* 493–500, *June* 3, 1938.—The structure and surface properties of monolayers and multilayers are frequently determined by the orientations of individual molecular layers, but under certain conditions a layer may undergo an almost instantaneous reversal of orientation. This overturning may alter the chemical and physical properties. It seems probable that the overturning of molecular layers may be a phenomenon of considerable biological significance. If the monolayers contain dipoles or ionic charges as well as hydrophobic and hydrophilic groups, the overturning of the layer may cause large changes of electric potential. Conversely, change of potential or of chemical composition of the liquid on one side of a membrane may cause an overturning of one or more of the monolayers and so change the properties of the film. The phenomenon of overturning may perhaps help to explain the mechanism of the propagation of nerve impulses. AUTHOR.

2740. Surface Electrification Due to the Recession of Aqueous Solutions from Hydrophobic Surfaces. I. Langmuir. *Am. Chem. Soc., J.* 60. *pp.* 1190–1194, *May*, 1938.—The progressively increasing contact potentials observed by Porter and Wyman [*ibid.* 59. *p.* 2746, *Dec.*, 1937] during the building up of calcium stearate multilayers of type X on alkaline solutions seem to be due to a surface charge on the uppermost monolayer rather than to the presence of dipole molecules within the film. A theory is given for the potential distribution produced by these surface charges and it is shown that with potential gradients of the order of 3×10^6 V/cm. over distances of a few Ångström units the contact potentials can increase at a linear rate of 70 mV per layer only up to films of a thickness of a few hundred layers. AUTHOR.

2741. Measurement of Superficial Electric Moments in the Midst of a Liquid. N. Choucroun and M. Arditi. *Comptes Rendus*, 206. *pp.* 1462–1464, *May* 16, 1938.—Electrophoresis and electroosmosis are explained by contact electrification due to a double layer, one part fixed on the surface of the particle and the other mobile in the liquid. If σ be the density of electrification and d the distance between the layers, σd is the superficial electric moment and is a measure of the importance of the electrification. The authors now measure these moments on surfaces containing adsorbed substances in various media, *e.g.* gamboge and mastic in $N/500$ HCl, distilled water, and $N/500$ NaOH. The results are in accord with Perrin's rule according to which the potential of a boundary is always increased by the addition of positive H ions and diminished by the addition of negative OH ions. Biological applications are referred to, and experiments with details of apparatus are included. H. H. Ho.

2742. Resistance and Capacity of Monofilms of Barium Stearate. C. E. Buchwald, D. M. Gallagher, C. P. Haskins, E. M. Thatcher and P. A. Zahl. *Nat. Acad. Sci., Proc.* 24. *pp.* 204–208, *May,* 1938.—The resistance and capacity of monomolecular films of barium stearate have been determined using an a.c. bridge with an auxiliary circuit comprising variable capacity and resistance introduced into one arm. Cr-plated electrodes were coated with the film and dipped in $CuSO_4$ solution. A. J. M.

2743. Contact Potentials of Stearate Films on Metal Surfaces. E. F. Porter and J. Wyman, Jr. *Am. Chem. Soc., J.* 60. *pp.* 1083–1094, *May,* 1938.—The contact potentials of various stearate films on stainless steel slides were determined by the vibrating plate method. *X*-films (*i.e.*, those, according to Langmuir, in which the molecules in successive layers are oriented in the same way) have comparatively high contact potentials, increasing with the number of layers. *Y*-films (molecules in successive layers oriented in opposite directions) have a small constant contact potential amounting to a few hundred millivolts. Sudden large jumps of potential can be caused by alternating the deposition of *X*- and *Y*-films. The high potential of *X*-films may persist for several days at room temperature. The effect of X-rays on both *X*- and *Y*-films is to produce large negative potentials, which in the case of *Y*-films can easily be discharged by dipping into water or by warming. *X*-films are not so readily discharged. The results are discussed in relation to theories of the structure of films. A. J. M.

2744. Surface pH. S. R. Craxford, O. Gatty and T. Teorell. *Phil. Mag.* 25. *pp.* 1061–1066, *June,* 1938.—Difficulties in applying various definitions of pH to interphases are discussed. A. J. M.

2745. Theory of Electrocapillarity. Part VII. Surface Films. S. R. Craxford, O. Gatty and T. Teorell. *Phil. Mag.* 25. *pp.* 1041–1061, *June,* 1938.—The electrocapillary equations developed [see Abstract 4040 (1936)] of this series are extended to the case of surface films. The equations are applied to a typical and to a simplified case. Existing data are insufficiently detailed with respect to all the component ions to allow the practical use of the precise electrocapillary equations. The boundary conditions for evaluating T and Γ terms are discussed in relation to the types of experimental data available. The theory of two coexistent surface phases is discussed. A possible factor contributing to the high capacities of specifically adsorbed anions is the possible existence of a gradual change from gaseous to condensed films of adsorbed anion at potentials close to those corresponding to the formation of a solid precipitate of a salt of the metal in the capillary electrode. Measurements of surface tension and chemical potentials cannot alone supply information as to the degree of dissociation of a substance in an interphase or in a surface film. [For Part VI see Abstract 2981 (1937).] AUTHOR.

2746. Motion of a Mercury Index in a Capillary Tube. G. D. Yarnold. *Phys. Soc., Proc.* 50. *pp.* 540–550; *Disc.,* 551–552, *July* 1, 1938.—The general case of the motion of an index of any liquid is considered theoretically and it is shown that the viscosity of the liquid can be determined by observation of the velocity of the index when different pressure-differences are applied between its ends. Experiments on the motion of mercury indexes are described; they lead to a value of the viscosity which is about 6% higher than the accepted value. The discrepancy is attributed to the electrification of the walls of the tube which continues to increase slowly even after the index has made several excursions along it. It is found that the difference between the angles of contact at the two ends is practically independent of the velocity of the index. AUTHOR.

See also Abstracts 2661, 2684, 2692, 2992.

TIME.

See Abstracts 2752, 2783.

VISCOSITY AND FRICTION.

2747. Molecular Force and Viscosity of Gases. Weng Wen-Po. *Phil. Mag.* 25. *pp.* 865–883, *June,* 1938. *Supplement.*—The connection between viscosity and molecular force is first discussed historically. It is then pointed out that in previous work by the author on atomic forces in solids that some success was obtained by assuming that the atomic force is composed of two independent parts—repulsive and attractive—and that for a number of substances, including nearly all elements, both parts of the force can be represented by inverse power laws of the distances which separate the atoms, and that both the indices are constants, or nearly so, for one group of substances, such as metals, non-metals, etc. The above results are now applied to the gaseous states and the following equation is derived :

$$\eta \times 10^6 = (\rho_l^{2/3} / \mathrm{M}^{1/6}) \times \sqrt{\tau} \times 37 \cdot 00[1 - 0 \cdot 370 \log_{10} \mathrm{LM} \times 10^7/\tau],$$

where η is the coefficient of viscosity in poises, ρ_l the density of the substance in liquid state at the normal boiling-point, M the molecular weight, τ the absolute temperature, and L the latent heat of evaporation in ergs. per gm. Data are given for H, He, Ne, A, Kr, Xe, N, O, Cl, Br, I and CO.

H. H. Ho.

2748. Operational Theory of Solid Friction. L. A. Pipes. *Phil. Mag.* 25. *pp.* 950–961, *June,* 1938. *Supplement.*—It is the purpose of this paper to present a discussion of the interesting and important phenomenon of solid friction by the use of the Laplacian transform or operational method of attack. The inherent simplicity of the approach to this non-linear problem makes it possible to obtain some interesting results most easily. AUTHOR.

See also Abstracts 2658, 2684.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***2749. Nebular Spectrograph of the McDonald Observatory. O. Struve, G. van Biesbroeck and C. T. Elvey.** *Astrophys. J.* 87. *pp.* 559–567, *June,* 1938.—A spectrograph for diffuse galactic nebulæ has been installed on Mount Locke. Emission lines of H and [OII] 3727 are found in several nebulous regions in Orion : IC 434, including the Horshead nebula, the dark region west of the Horsehead nebula, and the luminous edge of a dark nebula near BD + 12°814. Emission lines are also present in the nebula north-west of σ Scorpii. The red nebula near Antares shows a continuous spectrum. The continuous spectrum of the Orion nebula suggests a distribution of energy which is roughly similar to that of the Trapezium stars ; the continuous emission at the Balmer limit is weak or absent. The emission lines of the night sky are weaker at Mount Locke than at Williams Bay. AUTHORS.

See also Abstract 2783.

COSMOGONY.

2750. Relativistic Statics in the Interior of a Liquid Mass. L. Venturelli. *Accad. Lincei, Atti*, 27. *pp.* 224–231, *March* 6, 1938.—The gravitational field is studied in the interior of an ideal liquid in the stationary state. The author uses Levi-Civita's relations connecting the energy density ϵ with the geodetic curvature and the pressure, and applies them to the case of a static liquid. She finds that in first approximation V (the velocity of light) satisfies the equation: $V^2 = 1 - 2U/c^2 + \frac{1}{3}\kappa p\rho^2$, where U is the Newtonian potential of a field with the distribution of matter $\mu = \epsilon/c^2$, p is the pressure, κ is a constant and $\rho^2 = \sum_1^3 {}_r\chi^r$. L. K.

2751. Radiation Temperature of the Universe. W. Nernst. *Ann. d. Physik*, 32. 1–2. *pp.* 44–48, *May*, 1938.—On the theory of the author the red-shift of spectral lines is due to loss of energy of the rays in travelling through space. One may then assume that the universe is in a steady state and it is possible to calculate the density of radiative energy in the space between different nebulæ. The result is that the radiation temperature is about 0·75°, *i.e.*, about 1/4 of the temperature in interstellar space within the nebulæ. R. P.

2752. Linear Equivalence. E. A. Milne and G. J. Whitrow. *Zeits. f. Astrophysik*, 15. 5. *pp.* 342–353, 1938. *In English.*—The equivalence of accelerated particle-observers discussed by L. Page [see Abstract 2025 (1936)] is examined, and his use of the notion of equivalence is shown to lead to a discrepancy in clock rates when different observers' clocks are compared. It is shown that synchronisation of clock-zeros is an essential element in the notion of equivalence. Cosmological applications are briefly considered. [See also Abstract 2321 (1938).] AUTHORS.

See also Abstracts 2757, 2815.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

2753. Periodic Motion in Celestial Mechanics, and the Variation of Orbital Elements. Part I. H. Fabre. *Bull. Astronomique*, 10. 7–8. *pp.* 297–410, 1937.—This monograph outlines a theory of planetary perturbations which is based on Gyldén's "absolute orbits," suitably modified to overcome certain theoretical objections which may be urged against them. The problems considered are those in which a celestial body moves under the action of a gravitational potential depending on its coordinates and, in certain cases, on the time also. In part I the general equations of motion are put into a form in which Hansen's longitude figures as an independent variable. The perturbing potentials corresponding to various special cases are indicated, and functions are defined for the study of the motion of the nodes and apsides. In the particular cases in which the field of force possesses an axis of revolution and an equator, stable trajectories result, with no encounter between the attracting masses. Such trajectories are used to introduce the idea of absolute orbits, and approximations for these are obtained for the case considered, serving both for the true orbits and for the absolute orbits. A. Hu.

2754. Motion of the Apsidal Line in Close Binary Systems. Z. Kopal. *Roy. Astron. Soc., M.N.* 98. *pp.* 448–458, *April,* 1938.—The object of the present paper is to investigate the motion of the apsidal line in close binary systems the components of which are non-homogeneous ellipsoids with three unequal axes and polytropic density distributions. The mathematical analysis in the main part of the paper proceeds by direct integration of the respective equations of motion in the Lagrangian form, and has been carried out up to the second order in the ellipticities of both configurations. The main results are: (i) If the orbital period and the periods of axial rotations of both components happen strictly to agree, the longitude of periastron—apart from the periodic changes—advances secularly, the rate of motion being the higher the greater the relative dimensions of both components, the greater their distortions from the spherical form the lower their density condensations and the greater the orbital eccentricity. The major semi-axis and the eccentricity of the orbit remain secularly constant. (ii) But, in general, the nature of the problem requires that in such systems instead of a strictly constrained rotation, long-periodic librations of the components will take place. Then the following is found to be true:—(*a*) When the amplitudes of the librations are so small that their squares can be neglected, the apsidal line advances by the same amount as in the first case, *i.e.*, there are no additional terms to the secular motion of periastron due to small librations, but the orbital eccentricity decreases. (*b*) If the librations become larger, the problem has not been solved except for one special case. It is probable that new addtional terms would arise for the secular motion of periastron, but these will very probably be positive, *i.e.*, will make the advance of periastron faster. AUTHOR.

2755. Ellipticity of Close Binaries. W. J. Luyten. *Roy. Astron. Soc., M.N.* 98. *pp.* 459–466, *April,* 1938.—Owing to the failure of theoretical predictions of apsidal motion in close binaries to conform with the facts of observation, an attempt is made to estimate the degree of central density condensation in these stars from the observed ellipticities. For the three well-known ellipsoidal variables the ellipticities calculated from the light variations are found to be considerably greater than those permitted by theory. For a number of eclipsing variables the values found for ϵ/ϕ correspond to a central density condensation about the same as for the planet Saturn. AUTHOR.

LATITUDE AND LONGITUDE.

2756. Determination of the Constant of Nutation from the Greenwich Latitude Variation Observations. H. Spencer Jones. *Roy. Astron. Soc., M.N.* 98. *pp.* 440–447, *April,* 1938.—The material available in 25 years' observations (1911–36) with the Cookson floating zenith telescope at the Royal Observatory, Greenwich, has been analysed for the determination of the constant of nutation. The value obtained for this constant is 9″·217 ± 0″·004. The inferred value for the reciprocal of the mass of the moon is 81·53, on the basis of Newland's value of the luni-solar precession, or 81·59, on the basis of Oort's value, which takes galactic rotation into account. [See also Abstract 3692 (1930).] AUTHOR.

See also Abstract 2783.

NEBULÆ.

See Abstract 2749.

PLANETS.

2757. Theory of Planets and White Dwarf Stars. A. Sommerfeld. *N. Cimento*, 15. *pp.* 14–22, *Jan.*, 1938. *In German.*—Kothari has established a connection between the long-known planets and the recently discovered white dwarfs. The theory is discussed at some length, and developed. A number of extremely simple assumptions are made. (1) For the state under discussion the temperature is unimportant, and calculation may be made on the basis, $T = 0$ and complete degeneracy. This is evident for the planets, and is a profitable assumption to make for the dwarfs on account of their high density. (2) The density of matter in a given star is constant; and in both planets and dwarfs the compressibility is negligible. (3) Only Coulomb and Newtonian forces are considered, *i.e.*, forces depending on the inverse square of the distance. (4) The Coulomb forces are only effective within the several atoms, and do not affect the neighbouring atoms. (5) The atoms consist of a nucleus and electron "cloud." The electron density is assumed uniform, and not distributed in accordance with the Thomas-Fermi theory. The kinetic energy of the electrons follows directly from the limiting energy of the Fermi distribution for $T = 0$. (6) The calculations are made on the one hand for a star consisting only of Fe atoms, and on the other for H atoms. It is concluded that improvement of the Kothari theory is only to be expected when the Thomas-Fermi theory can be applied not to single atoms, but to the whole solid body. C. J. B. C.

2758. Plastic State of Planets. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 16. *pp.* 7–20, *March*, 1938. *In English.*—The moon and Mercury are perfectly elastic provided their internal temperatures do not greatly exceed that of the earth. In every planet investigated the horizontal compression within the crust is larger than the vertical, regardless of whether the condition of the crust is elastic or plastic. [See Abstract 1099 (1938).] W. A. R.

2759. State of Matter in the Interior of the Planets. R. Wildt. *Astrophys. J.* 87. *pp.* 508–516, *June*, 1938.—The bulk of mass in the interior of the planets is in the ordinary condensed state. Only in the central parts of Jupiter and Saturn may there be matter in a state approaching the degenerate one. This is concluded from the central pressures of the terrestrial planets, as evaluated by Jeffreys, and from the internal pressures of the giant planets, which are computed here for a model consisting of a core similar in structure to the terrestrial planets, covered by a layer of ice and a layer of solid hydrogen on top of it. In this hydrogen layer the conditions are realised under which hydrogen should change to a metallic modification predicted by theory. The condensation of ice VII from the primeval atmosphere must have started long before the temperature had dropped to the critical one, and probably was finished before the critical point was reached, which would imply that there never was on the giant planets an ocean of a depth comparable to the total mass of H_2O present. AUTHOR.

See also Abstracts 2753, 2756.

STARS.

2760. Comparison of Spectroscopic and Trigonometrical Parallaxes. H. N. Russell and C. E. Moore. *Mt. Wilson Observat. Contrib. No.* 589. *Astrophys.* J. 87. *pp.* 389–423, *May,* 1938.—The method of spectroscopic absolute magnitude calibration gives a regression-curve which inevitably underestimates the deviations of individual absolute magnitude (M), but this magnitude effect can be determined. Formulæ are developed for finding the constants involved and for their statistical errors. The real dispersion in M is found to be ± 34% in the parallax for 1140 main sequence stars, and ± 38% for a standard deviation; the means for any given sub-class are accurate (almost) to within 5%. For 732 giants, the parallaxes are smaller. Parallax standard deviation corresponding to real dispersion in M is ± 52%; that from spectroscopic errors ± 38%; the general means of spectroscopic and trigonometric parallaxes agree perfectly. 57 stars of great M indicate that the probable errors assigned in " Schlesinger's Catalogue " represent correctly the true accidental errors. Formulæ and tables are given for the rapid application of corrections to spectroscopic parallaxes, but should not be applied to supergiants. A. S. D. M.

2761. Radial Velocities of Some Early-Type Stars. R. F. Sanford and P. W. Merrill. *Mt. Wilson Observat. Contrib. No.* 591. *Astrophys. J.* 87. *pp.* 517–519, *June,* 1938.—Radial velocities are tabulated for 56 early-type stars not hitherto observed. Many are faint, and 32 fall within three rather small areas in Cygnus, Cepheus, and Cassiopeia. Six stars which probably are spectroscopic binaries are given in in a second table. AUTHORS.

2762. Radial Velocities of 917 Stars. W. E. Harper. *Dominion Astrophys. Obs. Victoria, Publ.* 7. 1. *pp.* 1–97, 1938.—The measured radial velocities for 2668 spectra of 917 stars are given. The stars are largely of Class A and the plates have been secured at Victoria from time to time during the past 15 years. For about 415 of these stars there have been no velocities published hitherto. 23 of the stars are found to be definitely in the spectroscopic-binary class, while 55 others are suspected of being binaries. For the stars having several fair lines there is a mean systematic difference between Victoria and the standard Lick Catalogue of − 1·0 km./sec. in the sense Victoria minus Lick Catalogue. AUTHOR.

2763. Spectroscopic Orbits of H.R. 5472. W. E. Harper and G. H. Blanchet. *Dominion Astrophys. Obs. Victoria, Publ.* 7. 2. *pp.* 99–104, 1938.—This spectroscopic binary discovered by Christie at Victoria in 1923 is found to be a 3-body system with a close pair mutually revolving about each other in a period of 101·56 days. This pair moves in an orbit about another body in a period of the order of 3320 days. 80 single-prism spectra form the basis of the determination of the elements of both orbits. AUTHORS.

2764. Visual Colour Excesses of Bright Stars in Cassiopeia. K. Graff. *Akad. Wiss. Wien, Ber.* 146. 2*a.* 9–10. *pp.* 605–610, 1937.—Following on measurements of the colour excesses of bright stars in Cepheus [see Abstract 1036 (1938)] similar measurements have been carried out on the adjoining region in Cassiopeia. This investigation was begun in Majorca in Jan. 1935 but had to be interrupted and was completed in Sept. and Oct. 1937 on the island of Solta off the Dalmatian coast. The results of measurements of 237 stars of 7^m and brighter are communicated in tabular form; these include besides Cassiopeia a part of Perseus containing the double star clusters *h* and χ Per. The region investigated is found to be very rich in stars with considerable colour excess; γ Cas is by no means an exceptionally deeply coloured star in this region. It is also noteworthy that most bright stars in a narrow region of − 3° galactic breadth adjoining the *h* and χ Per clusters show a considerable red coloration. J. E. K.

2765. Estimation of Spectral Type and Luminosity in B-Type Stars. E. G. Williams and D. L. Edwards. *Roy. Astron. Soc., M.N.* 98. *pp.* 467–476, *April*, 1938.—Williams's system of classification of B-type stars by means of ratios of photometrically measured line intensities is briefly summarised. It is shown that this method may be adapted to unstandardised objective-prism spectra by visual estimation of similar intensity ratios. Methods of estimation are explained and applied to 45 of the stars originally measured by Williams, with satisfactory results. A simple and rapid method is described of measuring wing widths of lines by means of a masking wedge. Widths measured in this way correlate well with the measured values of (total absorption)/(line depth), and are thus a good index of luminosity. The measures for H and He are plotted against absolute magnitudes as found by Williams, and give reduction curves which can be used for the determination of absolute magnitudes or parallaxes with greater accuracy than by previous spectroscopic methods. Tables and diagrams are given illustrating the results obtained (classification and luminosity) for the 45 stars investigated. AUTHORS.

2766. New Soluble Case of the Equation of Transfer for a Line Frequency. M. Krook. *Roy. Astron. Soc., M.N.* 98. *pp.* 477–482, *April*, 1938.—Solutions are given for the equation of transfer in the frequency ν of a line when the ratio $\eta_\nu = f(\nu)\{\alpha + \beta e^{-\lambda\tau}\}$. This functional form has the advantage that a displacement from one part of the line to another leaves the form invariant, position in the line being controlled only by the factor $f(\nu)$. Also the approximation $B_\nu = a_\nu + b_\nu\tau$, linear in the optical depth in the *continuous* spectrum, is used. AUTHOR.

2767. Evidence for Complex Structure in Lines of Interstellar Sodium. C. S. Beals. *Astrophys. J.* 87. *pp.* 568–572, *June*, 1938.—Complex structure has been observed in the profiles of narrow Na D lines appearing in the spectra of the three stars ϵ Orionis, ζ Orionis, and ρ Leonis. For each star the profiles of the Na D lines show a remarkable similarity to the profiles of the corresponding H and K lines of Ca II. The observations have been interpreted in terms of absorption by separate clouds or condensations of interstellar matter between the star and the observer. [See also Abstract 3529 (1936).] AUTHOR.

2768. Spectrum of γ Cassiopeiæ in the Photographic Region. R. B. Baldwin. *Astrophys. J.* 87. *pp.* 573–576, *June*, 1938.—The double emission lines began to narrow in Nov., 1936, and the spectrum became entirely one of single, narrow emission lines during the early summer of 1937. All lines became much stronger in the single-line stage. The spectrum was remarkable for the great number of lines of ionised iron, while the Balmer series was measured from Hβ to H32. One Ca III line was identified. Other elements found are Al II, Ca II, Cr II, He I, Mg II, Ni II, Si II and Ti II, while A II, Cr I, Mg I, Mn I, S II and Sc II are identified provisionally. Previous to and after the single-line stage which ended in Nov., 1937, the emission lines were divided by an absorption line. The intensity ratios of the two emission components of a line varied with time. AUTHOR.

2769. Colour Temperature Variations of γ Cassiopeiæ, and the Problem of "Yellow" B-Type Stars. W. M. H. Greaves and E. Martin. *Roy. Astron. Soc., M.N.* 98. *pp.* 434–439, *April*, 1938.—Colour temperature results are given for γ Cassiopeiæ. The brightening of the star in 1936 was accompanied by a strengthening of the emission lines and by a fall in the colour temperature. Between the autumns of 1936 and 1937 a further increase of the strength of the emission lines and a further decrease of the colour temperature took place. The general problem of "yellow" stars of type B is discussed. The available evidence indicates that in addition to a possible reddening due to selective space absorption, there is a reddening effect which is intrinsic in the stars, and which seems to be associated with the development of line emission. AUTHORS.

2770. Helium and Hydrogen Content of the Interior of the Stars. B. Strömgren. *Astrophys. J.* 87. *pp.* 520–534, *June*, 1938.—Recent investigations of the problems of energy generation and transmutation of the elements in the interior of the stars has led to the conclusion that the ratio of the content of He to the content of heavy elements is high, 6 being a lower limit of the ratio. This conclusion is discussed with the aid of the mass-luminosity relation. Chemical compositions are derived on the He hypothesis. The He hypothesis is found to be compatible with the mass-luminosity relation. No definite decision for or against the He hypothesis can be made on this basis alone. The assumption of a constant ratio of He to heavy elements leads to curves of constant H_2 in the Hertzsprung-Russell diagram which are very similar in nature to that previously obtained on the assumption of negligible He content. AUTHOR.

2771. Integral Theorem on the Equilibrium of a Star. S. Chandrasekhar. *Astrophys. J.* 87. *pp.* 535–552, *June*, 1938.—In this paper an integral theorem on the equilibrium of a star is proved which gives the lower limit to the value of $P_c/\rho_c^{(n+1)/n}$, assuming that both ρ and $P/\rho^{(n+1)/n}$ do not increase outward. As a special case of the theorem ($n = 3$) it is shown that for a gaseous star of a given mass in radiative equilibrium, in which ρ and $(1 - \beta)$ do not increase outward, the minimum value of $1 - \beta_c$ is the constant value of $(1 - \beta)$ ascribed to a standard model configuration of the same mass. For $n = \infty$ the theorem gives the minimum central temperature for a gaseous star with negligible radiation pressure. [See Abstracts 3455 and 3456 (1937).] AUTHOR.

2772. Minimum Integral in the Theory of Internal Constitution of Stars. W. Gleissberg. *Roy. Astron. Soc., M.N.* 98. *pp.* 571–575, *May*, 1938.—A continuation of previous work [see Abstract 1044 (1938)].

2773. Eclipsing Variable Star μ^1 Scorpii. P. Rudnick and C. T. Elvey. *Astrophys. J.* 87. *pp.* 553–558, *June*, 1938.—The eclipsing variable μ^1 Scorpii has been observed with a photoelectric photometer equipped with a potassium cell. With the spectrographic period of 1·44627 days, a light-curve is obtained, showing two unequal minima (0·29 and 0·18 mag.) and equal, rounded maxima. Orbital elements are deduced, giving partial eclipses of ellipsoidal stars with nearly equal radii. The inclination of the orbit is 62°. Combining this with the spectrographic data, the mass of the system is found to be 24·0 times that of the sun, and the mean density 0·074 times that of the sun; the effective temperatures of the two stars are found to be 13,000° and 17,000°, and the surface brightnesses 11·6 and 18·8 times that of the sun. AUTHORS.

2774. Spectrum of Nova Herculis. G. Järnefelt. *Soc. Scien. Fennica, Comm. Phys.-Math.* 9. 15. [10 *pp.*], 1938. *In German.*—Spectrograms of the Nova obtained at Helsingfors in Jan. and Mar. 1935 are compared with those of McLaughlin in the region 3900 to 5000 Å. The general agreement is satisfactory, but the author deals in detail with minor peculiarities. Special attention is paid to the regions near Hγ, Hδ, and λ4640, for which density contours are reproduced. Absorption IV in mid-March is apparently multiple, the H-lines being double. The violet displacements of the 2 components correspond to radial velocities of 860 and 760 km./sec. respectively. To the predominance of first one and then the other of these components are attributed the sudden fluctuations noticed by other observers in the Absorption IV velocity. The violet displacements of Hγ and Hδ are given in tabular form for Absorptions II, III, IV, IVa, and VII. On the Mar. 19 plate no trace is found of the strong emission band at λ4642, attributed to O II and N II by McLaughlin. No explanation is advanced, though it is pointed out that the brightness of the Nova fell by half a magnitude at the time. A. Hu.

2775. Catalogue of Orbits of Visual Binary Stars. P. Baize. *Bull. Astronomique*, 10. 7–8. *pp.* 273–296, 1937.

2776. Refractive Index of Interstellar Space. E. Schoenberg. *Zeits. f. Physik*, 109. 1–2. *pp.* 127–138, 1938.—The refractive index of a cloud of fine solid metallic particles is calculated and is shown to be largely independent of the density of the cloud and of the wave-length of the light. As an approximation to the true state of affairs a generalisation of the Rayleigh scattering formula is given, for the case of particles which not only scatter, but also absorb, light. G. C. McV.

See also Abstracts 2754, 2755, 2757.

SUN.

2777. Eruptive Prominences. M. Waldmeier. *Zeits. f. Astrophysik*, 15. 4. *pp.* 299–314, 1938.—New observational material is assembled from published examples of eruptive prominences occurring during the last 50 years. Some 40 accounts from 20 observers at 11 different observatories are compared with the data on which the discussion of Pettit [see Abstract 5044 (1936)] is based. The motion is traced not merely radially from the sun, but also in position angle, and, by means of the Doppler effect observed spectrohelioscopically, in the line of sight. Height-time diagrams verify Pettit's observation that the velocity of ascent is constant for some time and then increases suddenly to a new steady value, but fail to confirm that the new velocity is an integral multiple of the old. The general development of a prominence is described in detail from observations on the disc as well as at the limb, and it is noticed that the average prominence arises from a spot-free area. Neither the Milne theory nor that of Kiepenheuer fits the facts.
A. Hu.

2778. Sunspot Influences. R. E. de Lury. *Roy. Astron. Soc. Canada, J.* 32. *pp.* 105–132, *March, and pp.* 161–182, *April*, 1938.—A history is given of sunspot observation from the Chinese early records down to the latest telescopic ones. The author considers the questions of periodicity, vortex structure, magnetism, convection, temperature, faculæ, flocculi and prominences; the emission of u.v. light as an important variable; sunspots and the associated physical phenomena, such as variation of the coronal shape, of brightness in comets, of the Martian polar cap; of the aurora polaris, magnetic and thunder storms, temperature and precipitation. He investigates the association of the sunspot cycle with organic and economic fluctuations, such as of lakes and rivers, of trees, farm crops, diseases, migrations of insects, birds and animals, and finally with a table of the Commodity Prices in Britain for the interval 1784–1869, which exhibits a response to the sunspot cycle in inverse phase, and with a lag of a year. A. S. D. M.

2779. Probable Existence of Maximum Activity on Sun. I. L. Thomsen. *Roy. Astron. Soc. Canada, J.* 32. *pp.* 183–187, *April*, 1938.—The author considers the interval of about 19 solar rotations, between 1937 Jan. 24·0 and 1938 Jan. 185, finding a definite tendency for groups to cluster between 160° and 210°. He gives tables or diagram for (1) number of groups in each 40° of longitude; (2) of the positions (both in longitude and latitude) of the large, active groups which predominate between 4·100 and 260, and especially between 160° and 210°; (3) of the daily sunspot numbers (1937, Feb. 1 to Dec. 29); (4) of the positions of groups which returned in a second, third or fourth rotation. A. S. D. M.

2780. Stability Index of Solar Activity. H. Mémery. *Comptes Rendus*, 206. *pp.* 1451–1452, *May* 16, 1938.—Although the number and size of sunspots and faculæ vary greatly throughout any selected short or long period the variation of sunspots can be given by the ratio of (1) the number of sunspots visible, to (2) the number of days each sunspot is visible. For the year or solar period this ratio is approximately constant and gives a measure of the stability of the central part of the sun. Values are tabulated for (1), (2) and the ratio for a 60-yr. period. R. S. R.

2781. Age of the Sun and Disintegration Constant of AcU. Part II. S. Meyer. *Akad. Wiss. Wien, Ber.* 146. 2*a*. 9–10. *pp.* 581–588, 1937.—A continuation of a previous paper [see Abstract 542 (1938)]. Some recently published data from the investigations of J. Mattauch and V. Hauk on the distribution of isotopes of the various kinds of lead in ordinary lead and in Curite from Katanga have been collected. Hence it is disclosed that the "age" of the latest epochs of the sun amounts to about $4\frac{1}{2} \times 10^9$ yr.; the ratio of the masses of AU to U at present on the earth to $0{\cdot}0055 \pm 0{\cdot}0005$; and the decay constant of AcU to $1{\cdot}1 \times 10^{-9}a^{-1}$ and the half-value time to $6{\cdot}3 \times 10^8$ yr. J. J. S.

See also Abstracts 2815, 2855.

GEOPHYSICS.

GEODESY

2782. Determining the Geoid by Levelling. K. Muto. *Tokyo Univ. Earthquake Research Inst., Bull.* 16. *pp.* 60–69, *March*, 1938. *In English.*—Measurements were made by trigonometrical levelling to determine the difference in height between two triangulation points and it was found that it was of the same order as that obtained by precise levelling, *i.e.*, the height above the geoid, and that errors due to refraction were small. By taking into consideration the deviation of the vertical it is thus possible to determine the form of the geoid from height data obtained by geometrical and spirit levelling. R. S. R.

***2783. Theodolite Fitted with a Shutter Eyepiece. J. de G. Hunter.** *Roy. Soc., Proc.* 166*A*. *pp.* 197–213, *May* 19, 1938.—The moving-wire micrometer fitted to transit instruments for reducing personal errors in time determinations requires a chronograph and is too bulky for use on a field instrument for longitude work. The shutter eyepiece described in this paper has been designed for use with a theodolite and break-circuit chronometer. An opaque shutter close to the focal plane of the telescope objective exposes a star for observation for an instant at a time controlled by the chronometer. In practice the star is exposed for 0·070 sec. at every third second; and its successive positions are read by means of an illuminated scale consisting of 40 horizontal lines ruled at intervals of 0·001 in. on a glass plate. Time comparisons with the rhythmic signals from Rugby or Bordeaux are made by noting the complete extinction of an incoming signal by a contact, operated by the shutter, in the output circuit of the radio receiver. A full description is given of the trial longitude observations and their reduction. For a 2-hr. programme, a probable error of ±0·04 sec. in longitude is claimed with the equipment used. A. Hu.

GEOPHYSICS, APPLIED.

***2784. Design and Testing of Geophones and Their Amplifiers. E. C. Bullard and C. K. Grant.** *Roy. Astron. Soc., M.N. Geophys. Supplement,* 4. *pp.* 341–350, *May,* 1938.—From a brief outline of the principles of construction of geophones of the moving-coil type, the piezoelectric type and the Benioff type it is concluded that the latter type, in which the motion of the ground causes a change in the length of the air-gap in a magnetic circuit, is the easiest to construct and use. Theory is given of the operation of geophones of this type and the principles of design of such instruments are explained, a description being given of the construction of an actual instrument and of the associated amplifier and oscillograph. An account is also given of the tests carried out to ensure that the geophone and amplifier introduce no spurious frequencies into the records obtained and that amplifier and oscillograph are free from resonances and have a suitable frequency response. A. W.

HYDROSPHERE, PHYSICS OF THE.

2785. Tidal Variations of Temperature in the Irish Sea. J. Proudman. *Roy. Astron. Soc., M.N. Geophys. Supplement,* 4. *pp.* 373–386, *May,* 1938.—Reasons are given for expecting both semi-diurnal (M_2) and fortnightly (MSf) oscillations of temperature at stations in the eastern half of the Irish Sea. From observations taken twice daily at Solway light-vessel oscillations of both these periods are shown to exist and the results are graphed. A method of analysis of 8 years' observations, twice daily, is developed by which the constituents M_2 and MSf may be determined for each month of the year. Formulae are also obtained for the degree of determinacy of the results. The method is applied to observations from six stations in the area considered and the results are tabulated. The relation of the results to those of the analysis of ordinary tides is discussed. R. S. R.

2786. Fluctuations in Yearly Mean Sea Levels. K. Muto and N. Miyabe. *Tokyo Univ. Earthquake Research Inst., Bull.* 16. *pp.* 70–86, *March*, 1938. *In English.*—Changes in sea level are due to (1) astronomical and meteorological distrubances, and (2) crustal deformations. Of these (1) are partly periodic with short or longer periods and could thus be eliminated and the resulting change of sea level would be due to (2). Data were used for five stations, the terms of secular variation eliminated, and the residuals treated statistically. The fluctuation is irregular and in Japan the fluctuations are due to the joint effects of (1) and (2). The 18·6-year period has only a small effect. R. S. R.

2787. Density Currents in Connection with the Problem of Submarine Canyons. P. H. Kuenen. *Geolog. Mag.* 75. *pp.* 241–248, *June*, 1938.—General remarks are made first regarding the shape and origin of submarine canyons. Daly's hypothesis regarding erosion of the sides and the flow of water with dense suspensions down the slopes are discussed. Daly gives for the velocity of flow $v = c\sqrt{msd}$ where m is the hydraulic mean depth, s the axial slope and d the effective density. Experiments are described to determine c and the results are applied to flow in submarine canyons. Shepard's criticisms are discussed and it is concluded that while the hypothesis of density currents is open to doubt, slumping is an important factor in the sense of carrying materials from the walls to the bottom of the gorge and also down the canyon. R. S. R.

2788. Sea Disturbance. G. Weinblum. *Naturwiss.* 26. *pp.* 193–198, *April* 1, 1938.—The author distinguishes waves produced by wind action from those due to other causes. In the investigation he considers first hydrodynamical methods used by various people to obtain relations between wave-length, height of the wave, period, depth of water and the Jeffrey's "sheltering coefficient." Larger scale experiments he considers essential. In analysing statistical results he comments on the want of comparison of many observations. Pabst's sea disturbance buoy and the Kohlschutter and Laas stereophotogrammetric method give valuable results. The important quantities to be measured are discussed and the latest results are considered for different seas. R. S. R.

LAND, PHYSICS OF THE.

2789. Strength of the Earth's Outer Shells. R. A. Daly. *Am. J. Sci.* 35. *pp.* 401–425, *June*, 1938.—According to a suggested model for the earth a considerable part of the isostatic support of continents and high mountains is located in "anti-roots." The gravity anomalies, computed on the assumption that this model is correct in principle, would differ but little from the Hayford anomalies at the respective stations. Hirvonen's new values of gravity at 202 stations in the glaciated tract of north-western Europe indicate extremely small, if not zero, strength in the asthenosphere. Most of the fields of one-sign Hayford anomalies, computed by the 1930 International formula for the figure of the earth, seem to demand strength in the lithosphere of the same order as that calculated by Barrell and Jeffreys. On the other hand, the fields of peninsular India, interpreted on the same basis, would mean a highly improbable degree of strength for the lithosphere. This difficulty with the proposed earth-model is removed if we assume for the geoid a triaxiality of the kind deduced by Helmert, Berroth, Heiskanen and Hirvonen. AUTHOR.

2790. Dynamical Model for Elastic and Plastic Strains in Stones. R. H. Evans. *Leeds Philosoph. and Lit. Soc., Proc.* 3. *pp.* 492–497, *April*, 1938.—The elastic and plastic strain phenomena in stones are demonstrated by means of a dynamical model. The model consists of three elements, namely, (1) an elastic element, (2) an elastic-viscous element, (3) a plastic-viscous element. The equations for the total displacement of the elements at any instant are given and it is shown that the model is capable of reproducing (*a*) elastic or instantaneous strain, (*b*) elastic time strain which is dependent on time but is finally recoverable, (*c*) plastic time strain which appears as a permanent set. The model can also be extended to reproduce all the transverse strain phenomena in natural and artificial stones including the existence of a critical stress at which the transverse strains become abnormally high. AUTHOR.

2791. Effect of Temperature on the Electrical Constants of Soil at Radio Frequencies. R. D. Joshi. *Indian Journ. Phys.* 12. *pp.* 1–8, *March*, 1938.—Variation of dielectric constant and conductivity of soil with temperature from 0° C. to 105° C. at high radio frequencies have been determined by the substitution method by measuring the capacitance and resistance of a condenser with dry soil as dielectric. The conductivity was found to be of the order of $3 \cdot 4 \times 10^5$ e.s.u. at 0° C. and $8 \cdot 2 \times 10^5$ at 105° C. The value of the dielectric constant was found to be about 4·0 and it remained fairly constant with rise of temperature. The temperature coefficient of conductivity is found to be positive and the value is 2·0% per ° C. at 20° C. and it increases with the frequency. It has been concluded from these observations and also from some previous results that the value of conductivity of soil will be higher in summer and rainy season than in winter. AUTHOR.

2792. Dielectric Constant and Conductivity of Soil at High Radio Frequencies. S. S. Banerjee and R. D. Joshi. *Phil. Mag.* 25. *pp.* 1025–1033, *June*, 1938.—Conductivity and the dielectric constant of soil at ultra-high frequencies have been determined experimentally by measuring the actual attenuation of the waves in the soil. The soils tested were taken from different sites and depths. The above electrical constants are found at two different frequencies and different moisture contents. The value of the conductivity measured was of the order of 10^8 e.s.u. The conductivity increases with the frequency as well as the moisture content. For dry soil or soil of less moisture content the conductivity increased from a value of $1 \cdot 5 \times 10^8$ e.s.u. to a value nearly equal to $2 \cdot 6 \times 10^8$ e.s.u. Unlike the conductivity the dielectric constant diminishes with a rise of frequency, but it increases with moisture content. It varied from a value of nearly 4·5 at a moisture content of 6·3% to a value of 17·3 at a moisture content of 13·9%. The variation of attenuation constant is not very regular. Generally it is higher for moist soil and high frequencies. The conductivity of soil by the side of a river is not so high even at higher moisture content as other soils, which may presumably be due to the presence of sand in the soil near the river bank. The values of conductivity and dielectric constant obtained are small for Indian soil as compared with the values previously found in other countries. AUTHORS.

2793. Thermal Diffusivity of the Soil at Colombo Observatory. J. P. Andrews. *Phil. Mag.* 25. *pp.* 1066–1073, *June*, 1938.—The monthly means of underground temperatures at Colombo Observatory, derived from daily observations during the 15 years 1919–33, are subjected to Fourier analysis. From the resulting series, it is found that the thermal diffusivity of the soil has a value of about 0·009 c.g.s. units. AUTHOR.

METEOROLOGY.

2794. Gases and their Pressures in the Upper Atmosphere. S. K. Mitra and H. Rakshit. *Indian Journ. Phys.* 12. *pp.* 47–61, *March*, 1938.—In this problem two matters are of particular importance, (*a*) the height at which diffusive equilibrium begins to be important and (*b*) the different nature of the atmospheric constituents at different levels. As regards (*a*) previous observations point to this level being not under 100 km. In order to calculate the height of the diffusion level, the constituents of and the temperature in the upper atmosphere are examined. Starting from the 100 km. level as datum line at which both pressure and temperature are known from observations, then if the constituents are assumed to be N_2 and O there is diffusive equilibrium above 350 km., but if they are N_2 and O_2 then there is equilibrium above 250 km. From their investigations the authors conclude that (1) if disturbing causes are taken into account, diffusive equilibrium is important only at great heights; (2) amounts and pressures of constituent gases above certain levels are higher than those found by previous workers; (3) the constituents are N_2 and O_2 rather than N_2 and O. A. E. M. G.

2795. Upper Wind Forecasting. B. C. Haynes. *Monthly Weather Rev.* 66. *pp.* 4–6, *Jan.*, 1938.—The problem being to find a satisfactory method of representing the upper wind field, attention is first directed towards computation of a geostrophic wind scale. In a table are set out geostrophic wind values up to 14,000 ft., and a scale suitable for upper wind charts is reproduced. This enables upper wind charts to be constructed, the procedure followed in so doing being fully indicated. Examples show how the fields move and enable forecasts of the upper winds to be arrived at. It is hoped that by a method such as this, upper wind forecasting will be put on a more uniform basis. A. E. M. G.

2796. Direct Calculation of Wind Velocity. G. Tiercy and C. Golaz. *Arch. des Sciences*, 20. *pp.* 71–95, *March–April*, 1938.—Following a short introduction the necessary equations relating to wind velocity and pressure gradient, together with the relationships connecting the various quantities involved in them are set out. The variation of gradient with height is next considered. A particular solution of the general equation established, is obtained giving the value of u the wind velocity component along the x-axis. The perpendicular component is shown to be very small. A table gives the value of u, corresponding to a gradient $y = 1$ at the ground, up to 6000 m. assuming A constant and $= 9{\cdot}6$ in the expression $w/y = -9{\cdot}6 + Ae^{-12z/10^4}$. The variation of A is now investigated and the values of A between the ground and 6000 m. and also from 6000 m. to 14000 m. tabulated. The value for u at any height can therefore be obtained. A closer investigation of v the perpendicular component shows that up to 6000 m. it is negligible compared with u and that above this height it rises to 6% of u at 14000 m. and to 8·2% when z becomes infinite. A. E. M. G.

***2797. Accurate Determination of Dew Point. A. W. Hixson and G. E. White.** *Indust. and Engin. Chem.* (*Analytical Edition*), 30. *pp.* 235–240, *May* 15, 1938.—The apparatus features sensitive instrumental observation of dew, combined with minimisation of systematic errors in the measurement of the temperature at the gas-liquid interface. The technique is such as to eliminate the marked hysteresis error characteristic of methods involving continuous temperature change. An accuracy of ± 0·01° C. is reached. A double gaseous film adjacent to the liquid phase is hypothesised in explanation of observed phenomena. AUTHORS.

2798. Homogeneity of Longer Series of Rainfall Amounts in Europe. O. V. Johansson. *Soc. Scien. Fennica, Comm. Phys. Math.* 9. 13. [277 *pp.*], 1938. *In German.*—In obtaining a revised rainfall for Finland a general investigation was made of long series rainfall records over many parts of Europe. It was found advantageous to obtain lustrum means in each series and combine many stations over the area considered so as to eliminate errors in any one series due to local changes in site, method of measurement, or other causes and thus obtain corrected means. The method adopted is explained in detail. A very full statement is supplied for each area and criticisms of the results previously published are made. Rather than employ the whole of a long series it is better to use the best part and then account for variations by local changes sometimes of a secular character. It is concluded that the apparent increase of precipitation quoted by Wagner and Hesselberg and paralleled by increase of temperature and changes in the general circulation is yet very problematical. R. S. R.

2799. Presence of Sodium in the Upper Atmosphere. J. Cabannes, J. Dufay and J. Gauzit. *Comptes Rendus,* 206. *pp.* 870–872, *March* 21, 1938.—An interferential arrangement was used to analyse the structure of the radiation from the sky and distinguish that of the night sky from the yellow doublet of Na. Observations at Lyons show that the yellow radiation at night and at twilight is found from two distinct radiations with wave-lengths differing by an odd multiple of 6 Å. Since the ray obtained is centred at 5894 ± 1 Å and its width is ≯ 12 Å it acts as a doublet D_1D_2 of Na. Thus Na vapour is a permanent constituent of the atmosphere. The intensity of the yellow radiation of the night sky corresponds to 10^{11} transitions $3p^2P \rightarrow 3s^2S$ of the Na atom per sec. per m^2. [See Abstract 1094 (1938).] R. S. R.

2800. Yellow Radiation 5893 Å of the Twilight Sky and Presence of Sodium in the Upper Atmosphere. R. Bernard. *Comptes Rendus,* 206. *pp.* 928–930, *March* 21, 1938.—A Fabry-Perot interferometer was used to study the fringes produced by a Na flame through thin air layers and these fringes agreed with those obtained photographically from the twilight sky. The relative intensity of the components of Na doublet 5890 and 5896 Å was 2 : 1. The hypothesis favoured assumes the Na concentrated in a relatively thin layer near to a height of 60 km. Spectral observations of auroræ above 70 km. confirm this view since this radiation is absent. [See Abstract 1552 (1938).] R. S. R.

2801. Possible Presence of Certain Rays of the Neutral Na Atom in the Spectrum of the Night Sky. G. Déjardin. *Comptes Rendus,* 206. *pp.* 930–933, *March* 21, 1938.—The attributes of some rays observed in the night sky spectrum by Cabannes, Dufay and Gauzit should be considered provisional. A list of 12 rays is given which agree with certain members of the Na series and are due to the neutral Na atom. Reasons for the presence of these atoms are given and their origin, terrestrial or cosmic, is discussed. R. S. R.

2802. Photographic Measurements of the Great Aurora of January 25–26, 1938. C. Störmer. *Nature,* 141. *pp.* 955–957, *May* 28, 1938.—At nine S. Norway stations 710 successful photographs, many of them simultaneous, were made to fix the height and position of the aurora, 20 spectra were obtained, and many observations were made. In a preliminary account descriptions are given of the colour of the arc, rays, and corona and of their geographical situation. Rays were measured even to a height of 650 km., and all in the earth's shadow, indicating that the high atmosphere is lifted by big auroræ as by the sun. Two independent accounts are given of sounds heard which probably originate in the lower atmosphere. The spectra show lines at 6550, 6300, 5577 and 4278 Å. R. S. R.

*2803. **Robinson Cup-Anemometer and Various Types of Vanes. T. Sano.** *Imp. Marine Obs., Kobe, Japan,* 6. *pp.* 415–446, *March,* 1938. *In English.*—Experiments in a wind channel on a single cup fixed at various angles to the wind direction, are described. From these the mean driving force and its torque about the axis of revolution for a steadily revolving system in a uniform wind are computed. Of the two methods considered for deducing this force, one is shown to be satisfactory at least qualitatively, the other to be unsatisfactory. Five types of vanes are also examined and it is concluded that the optimum thickness and other characteristics of the cross-sections of such vanes have not yet been determined. Photographs of the instruments and records are reproduced. A. E. M. G.

See also Abstracts 2664, 2811, 2812, 2813, 2814, 2847, 2881.

SEISMOLOGY.

2804. **Rayleigh Waves. K. Sezawa.** *Tokyo Univ. Earthquake Research Inst., Bull.* 16. *pp.* 1–6, *March,* 1938. *In English.*—Continuing the work of a previous paper [see Abstract 1097 (1938)] it is shown that the values of the horizontal and vertical displacements in the resonance curves of Rayleigh-waves are themselves discontinuous at the same wave-length. W. A. R.

2805. **Earth's Outer Crust. P. Caloi.** *Ricerca Scientifica,* 9. *pp.* 334–338, *April,* 1938.—A new method for determining the depth of discontinuity from the P-waves is explained. The results applied to two earthquakes in Central Europe agree well with other methods. W. A. R.

2806. **Interconnection of Translational and Torsional Vibrations in Buildings. R. S. Ayre.** *Seismological Soc. of America, Bull.* 28. *pp.* 89–130, *April,* 1938.—The absence of torsional strains in a building subject to vibrations is important. It is assumed that in major earthquakes the motions are predominantly translatory, so that any torsional stresses that arise are due to the design of the building. The paper under certain assumptions investigates the plan of a building that will be free from torsional strains when subjected to translatory vibrations. It is shown that for buildings of one or two stories this condition will be obtained if the planning and properties of the structural units are symmetrically arranged. W. A. R.

2807. **Ellipticity Corrections to Seismic Waves. K. E. Bullen.** *Roy. Astron. Soc., M.N., Geophys. Supplement,* 4. *pp.* 317–335, *May,* 1938.—As in previous work [see Abstract 3494 (1937)], using geocentric latitudes, ellipticity corrections to waves through the earth's core are worked out and tables given for PKP, PKP_2, SKS, PKS, PKS_2, and SKKS; and formulæ (without tables) for SKP, SKP_2, and diffraction P and S. The corrections are in most cases correct within $\pm 0 \cdot 1$ sec., and at most within $\pm 0 \cdot 2$ sec. In the second paper ellipticity corrections to waves reflected at the central core are worked out for PcP, ScS, PcS and ScP. C. A. S.

***2808. Theory of Benioff Seismograph. E. C. Bullard.** *Roy. Astron. Soc., M.N., Geophys. Supplement,* 4. *pp.* 336–340, *May,* 1938.—The effect of the fact that H (the field in the magnet) is not a linear function of ϕ_m (the flux in the magnet), as assumed by Benioff, on the suitable dimensions of the magnet system is discussed, and tables are given for magnets made of 6% Co steel and of "Alni." [See Abstract 1398 (1933).] C. A. S.

See also Abstracts 2698, 2758, 2789.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

2809. Parabolic Relation between Flow of Electricity in Regions of Low Atmospheric Pressure and Ionisation by γ Rays. H. Mache and O. Moszkowicz. *Akad. Wiss. Wien, Ber.* 146. 2*a.* 7–8. *pp.* 493–504, 1937.—The ionisation flow in similarly ionised spaces is given by the differential equation for the ionic conductivity of gases if the recombination constant and ionic mobility can be assumed independent of the field and the term referring to diffusion can be neglected. The equation shows that in the current e.m.f. curve the points of equal degree of saturation lie on a parabola. The relation was proved by Knaffl but errors of 3% arise. A description of the apparatus used and the method employed to obtain a higher degree of accuracy are given. The results obtained are tabulated. The validity of the relation over the range of pressures is discussed. R. S. R.

• 2810. Electricity on Rain. F. J. Scrase. *Meteorolog. Office, Geophys. Mem.* No. 75. [20 *pp.*], 1938.—The data on which this investigation is based were obtained from continuous photographic records of the charge brought down by unit amounts of rain at Kew Observatory during the years 1935–6; a detailed description of the apparatus is given. The results of an analysis of the records showed that about three-quarters of the rain was positively charged, but owing to the fact that the charge per unit volume was, on the average, much greater in the case of negatively charged rain, the total quantities of positive and negative electricity brought down were not very different. On the whole, positive charge was slightly in excess. Showers were responsible for most of the high negative charges, whilst continuous rain and thunderstorms were generally associated with excess of positive charge. The potential gradient at the ground was much more often negative than positive during positively charged rain, but in negatively charged rain there was no marked tendency for the gradient to be of one sign rather than the other. The results appear to be consistent with the view that the electrification of shower clouds is brought about by the impact of ice crystals. It is suggested that the same process is responsible for the initial separation of electricity in a thundercloud, but that as a result of the more violent ascent of air local regions of positive charge are generated near the base of the cloud by the breaking-drop process. It is not clear how the electrification of continuous rain is produced, but it is believed that the prevalence of negative potential gradient in this type of rain is the result rather than the cause of the transfer of positive charge from the clouds to the ground by the rain. AUTHOR.

2811. Molecular Dissociation in the Upper Atmosphere. R. C. Majumdar. *Indian Journ. Phys.* 12. *pp.* 75–86, *March,* 1938.—A theoretical formula is developed to estimate the degree of molecular dissociation in the upper atmosphere under the action of the u.v. light of the sun. The dissociation of O_2 and N_2 is discussed and it is found that O_2 is completely dissociated at a height of about 167 km., *i.e.*, much above the E-region of the ionosphere, assuming a temperature of 300°K. and a molecular weight corresponding to the average mass of N_2 molecules. The constituents and the mechanism of fundamental processes in the ionosphere are discussed. AUTHOR.

2812. Centres of Thunderstorms and "Centres" of Sources of Atmospherics. R. Bureau. *Roy. Meteorolog. Soc., J.* 64. *pp.* 331–336, *April,* 1938.—Reference is made to the method devised by the author involving the use of two narrow-sector directional recorders on a base line to locate atmospherics, and the advantages of this method in comparison with synoptic meteorology, to locate thunderstorm centres, and to observe their development are discussed. They cannot however be used immediately for forecasting. The direction and rate of travel are largely determined by the wind at 2 km. and a wave length of 11,000 m. is most suitable for their detection. Their classification into stagnant and migratory disturbances is discussed. R. S. R.

2813. Height of Electric Currents near the Auroral Zone. A. G. McNish. *Terr. Mag.* 43. *pp.* 67–75, *March,* 1938. The author has suggested an extension of Chapman's theory regarding world-wide magnetic storms, in explaining intense magnetic disturbances near the auroral zone as due to electric currents resulting from dynamo action in the auroral zone. This action cannot occur above about 150 km. nor corpuscular streams below 200 to 300 km. The field changes in the auroral zone and Birkeland's and Chapman's calculations are described. A general theory is then given and it is applied to the special case of 15 Jan., 1933. Various heights for the current are considered and a broad current at 100 km. or less fits best. R. S. R.

2814. Theories of Magnetic Storms and Aurorae. S. Chapman. *Terr. Mag.* 43. *pp.* 77–79, *March,* 1938.—Reference is made to Hulburt's account of magnetic storms and aurorae, his criticisms of the corpuscular theory by Ferraro and Chapman and his u.v. light theory. The u.v. light theory cannot account for the sudden appearance and motion of auroral luminosity in rayed draperies and other mobile forms of aurorae. Some aurorae with notable radio fade-outs do not give magnetic storms. Hulburt's theory does not provide an adequate explanation of the time element for the westward drift in the atmosphere above dark and sunlit hemispheres, and the electric drift current along the auroral zone does not produce the required drift in direction and time. An alternative suggestion for the production of the polar current system is given. R. S. R.

2815. Interpretation of Terrestrial and Solar Magnetic Fields. J. Mariani. *Comptes Rendus,* 206. *pp.* 1247–1249, *April* 25, 1938.—A geometrisation of the electromagnetic equations generalising the inertia principle of Galileo, but not the geometry of the universe as by Weyl and Einstein-Meyer, is performed. It rests on the hypothesis that temporal spatial rotation in the universe of Minkowski with reference to a Galilean mark is also a movement of inertia. A kind of equivalence is thus established between motion caused by an electromagnetic field and the infinitesimal generalised rotation. Comparison of observation and theory for the sun and earth shows that the theoretical result for the earth is too small. The theory does not explain why the charge is conserved in spite of appreciable conductivity of the air, while atmospheric precipitation, solar radioactivity and cosmic rays exert an influence. R. S. R.

2816. Magnetic Storm of 16th April, 1938. J. Bartels and G. Fanselau. *Naturwiss.* 26. *pp.* 296–298, *May* 13, 1938.—On the morning of April 16, 1938, at 5 hr. 46·7 m., world time, there began a magnetic disturbance of unusual intensity which was recorded at the Adolf Schmidt observatory in Niemegk. The range of the disturbance was D 5° 28′, H 1900γ and Z 600γ, the greatest since 1890. By the use of instruments with a sensitivity of 26γ/mm., the whole disturbance was recorded, and the result was regarded as the strongest which has ever been recorded outside the polar-light zone. The main disturbance took place in the first two hours. During the storm, polar light was observed from German ships on the east coast of North America. In Norway, earth current effects set up voltages of over 300 in line systems, caused fuses to melt and sparks in telegraph offices. The greatest sun eruption hitherto observed in Zürich took place on the morning of 15th April and preceded the magnetic storm by about 21 hours. G. E. A.

2817. Earth Currents and Magnetic Perturbations. J. Bosler. *Comptes Rendus*, 206. *pp.* 964–966, *March* 28, 1938.—An examination of the curves obtained at Parc Saint-Maur over many years shows an exact parallelism with (1) the N-S component of the earth current (i) following the magnetic declination changes, and, (2) the E-W component following the horizontal force (H) changes. The relation takes the form $H = K2 +$ Const., where K is a constant. At some stations inertia in the moving system causes an apparent time lag between the two quantities. The earth currents are not due to induction caused by fluctuations in the terrestrial magnetic field but both have an extraneous cause. R. S. R.

2818. Stationary Air Currents in Closed Vessels. H. Benndorf and M. Mitlacher. *Akad. Wiss. Wien, Ber.* 146. 2*a*. 9–10. *pp.* 531–541, 1937.—It has been experimentally ascertained that the motions of needles of short-circuited electrometers observed by R. Stoppel [see Abstract 547 (1933)] are to be imputed to two causes: (1) those of short period to the variations of air pressure; (2) those of diurnal period to thermally set up and very regular variations of the pressure of the air in the electrometer vessel. In metal vessels even if they are set up in rooms in very good thermal equilibrium there circulate extraordinarily regular and lasting currents of air which can be made observable by various physical measurements, especially by ionisation measurements in large vessels. J. J. S.

See also Abstract 2791.

RADIOACTIVITY.

2819. Nuclear Disintegrations. T. Kahan. *Comptes Rendus*, 206. *pp.* 1289–1291, *May* 2, 1938.—In considering the work of Bethe, Gamow and Bohr on nuclear disintegrations the author makes use of the conception that the α-particle does not exist in the radioactive nucleus before the disintegration, but is formed only at the moment of its expulsion. The probability of a disintegration with emission of an α-particle is then composed of the probability of the formation of the particle and also of the probability of penetration across the crest of the potential wall. The effects of these assumptions are discussed. **Errata,** *ibid. p.* 1420, *May* 9, 1938. G. O. B.

2820. Nuclear Structure of Radioactive Substances. U. C. Bardhan. *Phil. Mag.* 25. *pp.* 1033–1041, *June*, 1938.—On the basis of the theory of Kar [see Abstract 3131 (1936)] on the spontaneous and artificial disintegration of atoms, an investigation is made of the variation of the surface potential of the hard core of radioactive elements. This surface potential is located at the boundary between the hard core and the surrounding shell of partially polarised circulating neutral He atoms. The elements studied are those belonging to the Ra, Th and Ac families. G. O. B.

2821. Atmospheric Radioactivity. G. Aliverti. *N. Cimento*, 15. *pp.* 66–67, *Jan.*, 1938.—Brief review of the apparatus and results obtained by applying the electrical effluvium methods to the determination of the radioactive content of the air. F. C. C.

2822. Collisions of Deuterons with Heavy Nuclei. Part I. E. Lifshitz. *Phys. Zeits. d. Sowjetunion*, 13. 2. *pp.* 224–243, 1938. *In English.*—The collisions of deuterons with heavy nuclei, accompanied by a disintegration of the deuteron with the capture of the neutron, are discussed. The cross-section for such reactions is calculated as the function of the deuteron energy. The distribution of the outgoing particles with respect to their energies is also determined. AUTHOR.

2823. Disintegration of Deuterons by Deuterons. J. Kreisler. *Acta Physica Polonica*, 6. 4. *pp.* 327–334, 1937. *In German.*—A calculation has been made of the effective cross-section for the disintegration of deuterons by deuterons, by means of a consideration of the reciprocal action between homogeneous particles. The probability obtained by this method differs little from that calculated by Dolch [see Abstract 2928 (1936)] which was obtained by a consideration of the reciprocal action between neutrons and protons. G. O. B.

2824. Yield and Energy of the Neutrons Produced in the Reaction $D_1^2 + D_1^2 = He_2^3 + n_0^1$. E. Baldinger, P. Huber and H. Staub. *Helv. Phys. Acta*, 11. 3. *pp.* 245–268, 1938. *In German.*—Using a discharge tube, neutrons are obtained by the D–D reaction, one neutron being produced per 8×10^6 deuterons at 100 ekV. From the recoil range of He atoms at 51°, measured with a linear amplifier, the energy of the neutrons was determined, the apparatus having been calibrated with α-particles of known energy. The total energy change in the reaction was found to be 3·1 eMV. The excitation curve agreed closely with that to be expected theoretically on Gamow's theory. F. C. C.

2825. Formation of ^5_2He by Collisions between Helions and Deuterons. F. Joliot and I. Zlotowski. *Comptes Rendus*, 206. *pp.* 1256–1259, *April* 25, 1938.—Heavy paraffin (98% D) was irradiated with α-particles from Po and the emitted particles examined in a Wilson chamber and a magnetic field of 80,000 gauss. The result indicates that the reaction is $^4_2He + ^2_1H \rightarrow ^5_2He + ^1_1H + Q$, with $Q = -0{\cdot}1 \pm 0{\cdot}3$ eMV. The corresponding mass of ^5_2He is $5{\cdot}0106 \pm 0{\cdot}0015$. This result is confirmed by a comparison of the paths of the particles emitted as above with that of those emitted when ordinary paraffin is similarly irradiated. C. A. S.

2826. Loss of Neutrons by Neutron Bombardment and the Radioactive Isotopes of Scandium. J. M. Cork and R. L. Thornton. *Phys. Rev.* 53. *pp.* 866—868, *June* 1, 1938.—The bombardment of Li by deuterons of 6·3 eMV energy yields neutrons of energy up to 20 eMV. These neutrons are in turn able to produce disintegrations by the ejection of two neutrons from bombarded nuceli. In the case of Sc there has been evidence that the process corresponding to the ejection of three neutrons also occurred thus producing Sc^{43} of half-life 4 hours and Sc^{44} of half-life 53 hours from the stable Sc^{45}. By varying the energy of the incident neutrons and observing the ratio of the two radioactivities produced, it now appears that these two activities are due to isomers of Sc^{44}. Hence there is no definite evidence as yet for the loss of three neutrons from the excited nucleus. Although Sc has but one stable isotope (Sc^{45}) there appear to be eight radioactive periods, six of which can be assigned with reasonable certainty to various Sc isotopes. The excitation function for the ejection of two neutrons is studied by observing the radioactivity produced at various energies of the incident neutrons. There is evidence of anomalous behaviour for certain elements. [See also Abstract 4243 (1937).] AUTHORS.

2827. Range-Distribution of α-Particles from ^{8}Li. C. L. Smith and W. Y. Chang. *Roy. Soc., Proc.* 166*A. pp.* 415–424, *June* 3, 1938.—The paper describes a method for determining the number-range distribution curve for the α-particles from radioactive Li. These α-particles are shown to consist of a continuous distribution extending up to a maximum of $6\cdot95 \pm 0\cdot1$ cm. ($7\cdot75 \pm 0\cdot05 \times 10^6$ eV). The shortest range observed was $0\cdot65$ cm. ($1\cdot2 \times 10^6$ eV), and in the region from $0\cdot65$ up to $6\cdot6$ cm. there is a linear relation between the logarithm of the number of α-particles and their range. Comparison is made with the distribution curves obtained by other workers and it is also shown that the upper limit of the energy of the α-particles explains the failure to observe the protons emitted in the reaction $^7\text{Li} + {}^2\text{D} = {}^8\text{Li} + {}^1\text{H}$. Upper and lower limits for the mass of ^{8}Li are calculated from the data and shown to be respectively $8\cdot0253$ and $8\cdot0246$. AUTHORS.

2828. γ-Ray Activity Induced in Cadmium by Slow Neutron Bombardment. S. Nakagawa and I. Sumoto. *Imp. Acad. Tokyo, Proc.* 14. *pp.* 106–107, *March,* 1938. *In English.*—When Cd is bombarded in a paraffin block the γ-ray decay curve shows periods of about 45 min. and 5 hr., but the β-ray decay curve does not show the short period but decreases continuously with a 5 hr. period when the Cd is protected from slow neutrons by a B_2O_3 filter, and faster with an initial period of 3 hr. when irradiated in a paraffin block. No definite interpretation is arrived at. N. M. B.

2829. Intensity of γ-Radiation Produced by Slow Neutrons. R. D. Hill and A. A. Townsend. *Phys. Soc., Proc.* 50. *pp.* 534–539, *July* 1, 1938.—Intensities of γ-rays produced by absorption of slow neutrons have been measured for eleven elements. The results for thermal neutrons are used to calculate relative values of p, the probability of production of a γ-ray quantum by an absorbed neutron. In general, the values of p so found lie close to unity (which is the value assumed for Cd). This observation is discussed in relation to the absolute magnitude of p, and it appears likely, in fact, that p is of the order of at least five in the elements investigated. Measurements have also been made of the γ-ray intensities as a function of the thickness of specimen for the elements Ag, Cl and Hg. These lead to approximate determinations of the absorption coefficients of thermal neutrons in these elements. For slow neutrons of greater than thermal energies, the γ-ray intensities have been used to obtain the relative cross-sections for γ-ray production. AUTHORS.

2830. Binding Energy of the Atomic Nucleus and α-Decay. V. Cherdynzev. *Phys. Zeits. d. Sowjetunion,* 13. 2. *pp.* 170–180, 1938. *In English.*—The model of a liquid nucleus is used. In the expression of nuclear energy, the surface forces are taken into consideration. The relation obtained is experimentally verified. Using the theoretical expression for the energy as a function of the atomic weight, a relation between the α-decay energy and the atomic weight is obtained. Positive values of the α-decay energy are found for a narrow region of heavy nuclei. This enables the relation between the life-time of α-emitters and the atomic weight to be correctly explained. AUTHOR.

2831. Upper Limit of Energy of the Continuous β Spectrum of the Radioelements. A. Baschwitz. *J. de Physique et le Radium,* 9. *pp.* 120–122, *March,* 1938.—Reference is made to a previous paper in which an experimental investigation was made of the employment of the "method of absorption" for the determination of the upper limit of energy of the continuous β-spectrum of RaE. The apparatus used was an electroscope. An account is now given of the further results obtained when the electroscope was replaced by a Geiger counter. The investigation has been extended to other natural radio-elements, and the conditions of the employment of the method are considered. The method has been extended to measure the upper limit of β-energy of some artificial radio-elements. J. J. S.

2832. Absorption of β-Rays of Radioelements. M. E. Nahmias and L. I. Schiff. *J. de Physique et le Radium,* 9. *pp.* 140–144, *April,* 1938.—A method of measuring the absorption of β-spectra, taking into account certain necessary corrections, is evolved, and confirmed by experiments on the spectra of the following artificial radioelements: Ra-Al, Ra-Ag, Ra-Rh, Ra-I, and Ra-Dy. A radiation of the order of 100 kV. emitted by Ra-Ag (22 sec.) is reported. N. M. B.

2833. Absorption and Diffusion of β-Rays in Cellulose Acetate. R. Arnoult. *J. de Physique et le Radium,* 9. *pp.* 145–148, *April,* 1938.—Using semi-circular magnetic focusing and two coincidence counters, the absorption and diffusion of β-rays emitted by the radioactive deposit of thoron were examined. Data were obtained for absorption in cellulose acetate for β-rays with energies lying between 24–220 ekV. Application of the results to the energy spectra of induced β-ray emitters of low energy is suggested. F. C. C.

2834. Emission of Ionising Radiation by Dried Plants. F. Artigas. *Comptes Rendus,* 206. *pp.* 1200–1202, *April* 11, 1938.—In continuation of previous work [see Abstract 5295 (1937)] dried specimens of rape seed, parsnips and tobacco, have been tested for emission of ionising radiation. It is again shown that the radiation intensity is proportional to the % of K in the dried sample. The detection of radioactivity was found to be limited by the sensitivity of the Pohl electrometer, to a minimem of 5% content of K, for which reason, living tissue with about 1% content of K gives no reaction. Measurements have therefore been made, using a tube counter with Al walls 9μ thick. The activity measured with this counter is shown to be proportional to the surface of irradiation. T. A. C.

2835. β-Transitions in a Coulomb Field. F. Hoyle. *Roy. Soc., Proc.* 166*A*. *pp.* 249–269, *May* 19, 1938.—This paper attempts to give the selection rules, and the possible forms of the electron energy spectra, which correspond to elements on the first, second, and third Sargent curves, in the case of each of the possible forms of β-interaction belonging to Hamiltonians that contain a derivative of only the neutrino wave function. The accurate solution of the problem would require a knowledge of the wave equation of a nucleus containing many particles. Three groups of components of the wave functions (the large components and two groups of small components) are arrived at in the treatment, and a comparison of the selection rules for the three groups and a discussion of the corresponding forms of the electron spectra lead to various possible conclusions on the electron distributions of elements on the second and third Sargent curves. N. M. B.

***2836. Statistical Theory of a Scaling Circuit. L. Alaoglu and N. M. Smith, Jr.** *Phys. Rev.* 53. *pp.* 832–836, *May* 15, 1938.—The over-all efficiency of a counter circuit embodying a scaling circuit to reduce the rate of recording is investigated. The probability of detecting counts ($G(n, \tau)$) of a scaling circuit and a recorder fed with random impulses is shown to be: $1 - I(\mu\tau, n)$, where n is the scale of the circuit, τ the resolving time of the recorder, μ the statistical average of incoming counts, and where $I(\mu\tau, n)$ is the ratio of the incomplete gamma-function with upper limit $\mu\tau$ of n to the complete gamma-function of n. Efficiency curves ($100\,G(n, \tau)$) are plotted showing that the distribution in time of the impulses leaving the scaling circuit is no longer random, but is a distribution in which the extreme short and long intervals between impulses are averaged out. The average rate of recording counts (μ_n) is $(\mu/n)G(n,\tau)$. The analysis is extended to include the effect of the finite resolving time of the amplifier (σ), yielding when $\tau \gg n\sigma$: $\mu_n = (\mu/n)\ [1/(\mu\sigma + 1)]\ [1 - I(\mu(\tau - n\sigma), n)]$, and when $\tau < n\sigma$: $\mu_n = (\mu/n)[1/(\mu\sigma + 1]$, the latter being the response of the amplifier alone. Thus, one need only make $n > \tau/\sigma$ and the scaling circuit and recorder will operate with 100% efficiency. AUTHORS.

***2837. Valve Control Circuit for Cloud Chambers. J. R. Richardson.** *Rev. Sci. Instruments*, 9. *pp.* 152–154, *May*, 1938.—Using an improved valve circuit it has been found possible to eliminate the usual motor and cam arrangement when operating the time devices of a cloud chamber. It is found preferable to use a high capacitance rather than a high resistance to avoid fluctuations due to variations in humidity and temperature. F. C. C.

***2838. Operation of Tube Counters. O. Zeiller.** *Zeits. f. Instrumentenk.* 58. *pp.* 207–209, *May*, 1938.—Details are given of the construction of reliable tube counters. Using coincidence methods, the efficiency of such counters is found to be more than 99% when tested with cosmic rays. Constancy with time was observed over a period of two months. F. C. C.

***2839. Time of Tube Counter Impulses. J. M. Lyshede and J. C. Madsen.** *Zeits. f. Physik*, 108. 11–12. *pp.* 777–779, 1938.—By applying periodic potentials to a tube counter, the time characteristics of the counter were determined. The effect of changes in the counter circuit were examined and the maximum possible rate of counting was deduced. F. C. C.

See also Abstracts 2781, 2809, 2843, 2852, 2977, 2983, 3004.

RADIATION.

ABSORPTION.

2840. Change in Absorption of Water at $4\cdot7\mu$ Due to Solutions. E. K. Plyler and E. S. Barr. *J. Chem. Phys.* 6. *pp.* 316–318, *June*, 1938.—A study has been made of the absorption of aqueous solutions of some halogen salts in the region of $4\cdot7\mu$. It has been found that KF shifts the bands to shorter wave-lengths, while KCl, KBr, and KI shift the band to longer wave-lengths. The effect is explained as due to changes in hindered rotation as produced by the binding forces between the ions and water molecules. The changes in position of the band vary with concentration. The kind of positive ion does not seem to change the effect when the same negative ion is in solution. AUTHORS.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

2841. Application of Quartz Crystals to the Modulation of Light. D. W. R. McKinley. *Canad. J. of Research,* 16. *Sect. A. pp.* 77–81, *April,* 1938.—The resonating X-cut quartz crystal has been used as a self-compensator for white light modulation. The properties of the 49° cut quartz crystal are described. This crystal combines low power input and stable high frequency with a wide light aperture and improved light output. For many purposes a convergent beam of light may be used, without the need of a compensating device. AUTHOR.

EMISSION.

2842. Invariance in the Neutrino Theory of Light. B. S. M. Rao. *Indian Acad. Sci., Proc.* 7*A. pp.* 293–295, *April,* 1938.—The essential point of the neutrino theory of light is the setting up of a relation between the neutrino operators and the photon operators such that while the former satisfy the commutation laws of the Fermi-Dirac statistics the latter satisfy those of the Einstein-Bose statistics. In this paper the question of Lorentz invariance of this fundamental relation connecting the two sets of operators is examined, and by consideration of rotations of the frame of reference it is shown that the relation itself is not invariant. N. M. B.

2843. New Experimental Evidence for the Existence of a Neutrino. H. R. Crane and J. Halpern. *Phys. Rev.* 53. *pp.* 789–794, *May* 15, 1938.—A new method is used for determining the energy of recoil of the nucleus in the individual β-disintegration process. A gaseous compound of radiochlorine is placed in a cloud chamber. The clearing field is removed long enough before the expansion to allow the ions to spread out so that the resulting droplets can be seen individually. A cluster of droplets appears at the beginning of the track, and this is believed to be reproduced by the recoil nucleus. From the number of droplets an estimate is made of the kinetic energy of the nucleus, and this is compared with that calculated from the observed curvature of the β-ray track. It is found that the laws of momentum as well as those of energy indicate that a third particle participates in the disintegration. AUTHORS.

2844. Materialisation of a Photon in an Electron Field. A. M. da Silva. *Comptes Rendus,* 206. *pp.* 1365–1367, *May* 9, 1938.—During Wilson track experiments on β-rays, a triple fork was photographed due to a positive electron and two negative electrons, and evidence indicates that this fork results from the materialisation of a photon, not in the field of the atomic nucleus, but in the field of the outer electrons of the atom. Energy measurements are in satisfactory agreement with calculations based on theory. N. M. B.

2845. Suggested Explanation of the Contradiction between the Rayleigh-Jeans Formula and Experiment. P. B. Carwile. *Phil. Mag.* 25. *pp.* 926–930, *June*, 1938. *Supplement.*—Reasons are advanced, on classical grounds, to show that modes of resonance do not exist for radiant energy in free space bounded by a material surface. This leads to the conclusion that the Rayleigh-Jeans formula is not theoretically applicable to the partition of energy between space and a material body. [See Abstract 1690 (1905).] AUTHOR.

2846. Propagation of Light in an Atomically Stratified Medium. Part II. J. Weigle and J. Patry. *Helv. Phys. Acta*, 11. 3. *pp.* 181–188, 1938. *In French.*—Continuing the calculations of a previous paper [see Abstract 1976 (1938)], the authors now assume the individual elements of the medium to be anisotropic with a tensor instead of a scalar dielectric constant. As before, a periodic variation of dielectric properties in one direction in the medium is assumed. The calculations show that the effect of this spatial anisotropy on the double refraction of the medium is comparable with that found in the simpler case of a scalar dielectric constant. It is suggested that the effects to be expected with actual crystals, which represent media periodic in three dimensions, will not be essentially different from those calculated for the one-dimensional model W. S. S.

2847. Photon Emission of a Black Body. A. E. Haas. *J.O.S.A.* 28. *p.* 167, *May*, 1938.—The total number of photons emitted by a black body in thermodynamical equilibrium is found to be $1\cdot5 \times 10^{11} \times T^3$ photons per sec. per cm^2. The total number of photons emitted by the sun in a period of about 20,000 years equals the total number of protons and neutrons contained in the sun. AUTHOR.

2848. Detection of Cosmic Rays and Neutrons by Photographic Plates. M. Blau and H. Wambacher. *Akad. Wiss. Wien, Ber.* 146. 2*a*. 7–8. *pp.* 469–477, 1937.—Photographic plates were left for 5 months at an altitude of 2300 m. and were found, on development, to show large numbers of tracks, which are attributed to protons in the cosmic radiation; either primary or as a secondary result of neutron collisions. The lengths of the tracks corresponded to ranges from 10 cm. to 6·5 m. in air. An attempt was made to investigate the spontaneous neutron emission from P irradiated with fast neutrons, plates being examined for the tracks of recoil-protons arising from neutron collision, but without success: in this case tracks due to radioactive contamination masked any effect of the kind sought. [See following Abstract.] D. H. F.

2849. Direct Photographic Detection of Heavy Particles in Cosmic Radiation. M. Blau and H. Wambacher. *Akad. Wiss. Wien, Ber.* 146. 2*a*. 9–10. *pp.* 623–641, 1937.—Detailed examination of photographic plates, with an emulsion 70μ thick, kept for 4 months at an altitude of 2300 m., revealed tracks attributable to cosmic radiation averaging 0·064 per cm^2. per hour, counting only tracks with a length corresponding to a range of $\gg$ 10 cm. in air. Approximate evaluations of the energy for tracks not stopping in the emulsion were made from the density of the grains in the tracks. Most of the tracks are considered to be due to recoil protons from neutron collisions, and protons arising from nuclear disintegrations, starting outside the emulsion. 31 groups of particles radiating from a point, and representing atomic disintegrations, are described in detail;

in at least four of these the energy involved is considered to be > 200 eMV [See preceding Abstract.] D. H. F.

2850. Variation of Cosmic Radiation Intensity with Local and Sidereal Time at 2300 cm. A. Demmelmair. *Akad. Wiss. Wien, Ber.* 146. 2*a*. 9–10. *pp*. 643–659, 1937.—The results of ionisation chamber measurements over the year starting March, 1936, are detailed. Special precautions were taken to reduce external radioactive effects to a minimum. The temperature and barometer corrections are detailed. A daily variation with local time averaged over the whole year was established. There was a maximum at midday and a minimum around midnight, corresponding to a minimum and a maximum respectively in the horizontal intensity of the earth's magnetic fluid. A sidereal time variation as required by Compton and Getting could not be found. The previously found drop in intensity during the summer months of about 1·25% of the mean intensity, and the corresponding increase during the winter, was confirmed. D. H. F.

2851. Cosmic Rays. B. Rossi. *N. Cimento*, 15. *pp*. 43–65, *Jan.*, 1938. *Elettrotecnica*, 25. *pp*. 263–266, *April* 25, 1938.—Reviews of the present-day knowledge of the subject.

***2852. Cosmic-Ray Counter with High Resolving Power. R. Maze.** *J. de Physique et le Radium*, 9. *pp*. 162–168, *April*, 1938.—In order to obtain a coincidence counter of great accuracy and high resolving power, it is necessary to make the time constant of the circuits containing the counting tubes very low. Further, one has to make sure that the impulses of varying intensity which are transmitted by the counting tubes are brought up to about the same intensity in intermediate stages before they are applied to the valve selecting the coincidences. A four-stage amplifier system, designed on these lines is described in detail. R. P.

2853. Specific Ionisation and Mass of Cosmic-Ray Particles. D. R. Corson and R. B. Brode. *Phys. Rev.* 53. *pp*. 773–777, *May* 15, 1938.—The specific ionisation of 120 cosmic-ray tracks has been measured by counting droplets in photographs of delayed expansion cloud chamber tracks. For values of $H\rho$ between 10^3 and 2×10^5 the specific ionisation as a function of $H\rho$ is found to be in good agreement with theory. The predicted minimum ionisation for electrons of $H\rho \sim 10^4$ (~ 2 eMV) is verified. These results are applied to the calculation of the mass of heavily ionising cosmic-ray particles as observed by us and by others. The masses of all heavy cosmic-ray particles thus far reported, with one exception, do not seem to be in serious disagreement with a unique mass which lies in the limits $(200 \pm 50)m_0$. AUTHORS.

2854. New Light on the Nature and Origin of the Incoming Cosmic Rays. I. S. Bowen, R. A. Millikan and H. V. Neher. *Phys. Rev.* 53. *pp*. 855–861, *June* 1, 1938.—Cosmic-ray electrons enter the atmosphere only in a definitely limited and relatively narrow energy range. The maximum of this energy distribution curve lies at about 6×10^9 eV. At 10^9 eV the curve has fallen to about a third of its maximum value, and on the other side of the maximum at some 17×10^9 eV the incoming energy also has about a third of its maximum value. The observed banded structure may possibly be partly due to the blocking effect of the sun's magnetic field on electrons trying to pass through it to the earth. The total cosmic-ray energy brought in by electrons of energy above 17×10^9 eV plus all that brought in by photons of all energies is about the same as the energy brought in by electrons alone of energies between 6 and 17×10^9 eV, and this energy is fully twice that brought in by all entering electrons of energies less than 6 × 10^9 eV. The smallness of the fraction of the total incoming energy that can be assigned to photons shows that the cosmic rays cannot ever have come through an appreciable amount of matter in comparison with an atmosphere before entering the solar system. The energies of the incoming rays correspond roughly to the annihilation energies of the atoms of the most abundant elements. AUTHORS.

2855. Influence of the Solar Magnetic Field Upon Cosmic Rays. P. S. Epstein. *Phys. Rev.* 53. *pp.* 862–866, *June* 1, 1938.—The heliomagnetic field has a considerable influence on the intensities of cosmic rays as measured upon the earth in high magnetic latitudes and elevations. The difference of intensities (integrated over the whole atmosphere) between Omaha and Saskatoon is decreased by it to the extent of about 50%. Diurnal and annual variations of the solar effect are calculated. They lie below or just on the verge of the present experimental error. AUTHOR.

2856. Energy Loss of Penetrating Cosmic-Ray Particles in Copper. J. G. Wilson. *Roy. Soc., Proc.* 166*A. pp.* 482–500, *June* 16, 1938.—A description is given of measurements of the energy loss of cosmic-ray particles in a Cu plate, made by means of the cloud chamber method, and the measurements are compared with those previously made in Pb. The results show that the initial reduction of relative energy loss $(1/E)$ (dE/dx), with increasing energy is probably rather less rapid in Cu than in Pb, but there is no indication that the Bethe-Heitler value for the radiation loss applies to markedly higher energies in the lighter element. For both Pb and Cu there is a maximum of relative energy loss at $E \sim 1{\cdot}5 \times 10^9$ eV. It is shown that this loss is not accompanied by the secondary particles to be expected if it were due to the emission of collision radiation. Further, the value of the relative cross-section in this region varies with the absorber less rapidly than Z^2, and the position of the maximum is almost independent of Z. Absorption of this type will become of particular importance for elements of low atomic number, and it is suggested that the absorption with a maximum at $E \sim 1{\cdot}5 \times 10^9$ eV is responsible for the anomaly in the sea-level energy spectrum of cosmic rays at $E \sim 2{\cdot}5 \times 10^9$ eV. AUTHOR.

2857. Showers Produced by Cosmic Radiation. W. Heitler. *Roy. Soc., Proc.* 166*A. pp.* 529–542, *June* 16, 1938.—The theory of the heavy electron developed by Fröhlich, Heitler and Kemmer [see Abstract 2206 (1938)] has been applied to the passage of fast heavy electrons through matter. It is shown that various types of showers are produced (Y = heavy electron, P = proton, N = neutron). (1) $Y^+ + N = P + h\nu$. The light quantum produces an ordinary cascade shower. (2) Multiple processes of the type $Y^+ + N = P + Y^+ + Y^-$ and of higher order are possible. They lead to penetrating showers produced by penetrating particles. (3) In a heavy nucleus: $Y^+ + N = P$. The energy of Y^+ is restored in the nucleus which subsequently evaporates emitting a few protons and neutrons (proton shower) accompanied possibly by electrons and also heavy electrons. The inverse process to (1) leads to the creation of heavy electrons by light quanta. It is shown that the order of magnitude of the cross-section is sufficient to explain all heavy electrons at sea-level as secondaries produced in the high atmosphere. Owing to the breakdown of the theory for energies $\gg \mu c^2$ (10^8 eV) all these processes can only be discussed qualitatively and their cross-section can only be calculated approximately for energies of the order 10^8 eV or less. For this energy the cross-sections have a reasonable order of magnitude. AUTHOR.

2858. Atmospheric Absorption of Cosmic Rays. B. Gross. *Gerlands Beitr. z. Geophys.* 53. 1–3. *pp.* 213–222, 1938.—The problem of the explanation of the variation of cosmic-ray intensity with height in the atmosphere, in terms of the interaction between the radiation and matter, and of the distribution of energy in the primary radiation, is discussed in general; and the attempts made at its solution by various authors are reviewed. D. H. F.

***2859. Dielectric Bolometer. P. Moon and L. R. Steinhardt.** *J.O.S.A.* 28. *pp.* 148–162, *May*, 1938.—Bolometers of the Langley type, type, etc., have been limited in sensitivity by (*a*) a low temperature coefficient obtainable with metals, and (*b*) low resistance. The paper describes a new form of bolometer in which the metallic plates are replaced by sheets of insulating material. The theory of the method is first developed and various materials are considered and their sensitivities are calculated. These range from 2 to 135 V per W/cm^2. at room-temperature, with 100 V, 1000 $\sim$ applied to the dielectric. The theoretical limit is 20,000 and a value of 9,000 is calculated for glass at 100° C. and 60 $\sim$. Bolometers were constructed of cellophane and pliofilm, the latter giving a sensitivity of 12·5 with 8·5 V corresponding to 148 with 100 V. A comparison of the new instrument with other types shows that it is not well suited for spectroradiometric measurements, but should be most useful where its large target can be used advantageously and where its ruggedness and portability are of importance. A comprehensive Bibliography is appended. E. H. D.

***2860. Luminous Source of Great Brilliance. M. Vaudet.** *Ann. de Physique*, 9. *pp.* 645–722, *May–June*, 1938.—Describes the result of an examination dealing with the duration and temperature of a fine wire exploded by means of a 100 kV condenser discharge. The electrical system is described in detail, the problem of closing the circuit requiring the development of a special switch. Using the Anderson rotating-mirror method, the duration of the explosion is found to vary from 10 to 20 μsec., and the various factors affecting this time are discussed. Direct photography of the explosion, although not very accurate, shows that the temperature of the vapour sometimes exceeds 20000° Abs. A spectrographic examination of the light emitted in the u.v. and Schumann regions shows a number of reversed lines as well as some unusual results. It is suggested that the production of continuous spectra is due to collisions between neutral molecules moving at large relative speeds. Finally, other uses of the energy stored in the condenser group are suggested, namely the production of intense magnetic fields, and instantaneous ultramicroscopy. R. C. F.

See also Abstracts 2647, 2726, 2871, 2945, 2999.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

2861. Spectral Investigations of Fluorites. G. Wild. *Akad. Wiss. Wien, Ber.* 146. 2*a*. 7–8. *pp.* 479–492, 1937.—Continuing along the lines of the investigations of Haberlandt, Karlik and Przibram [see Abstract 165 (1938)], a spectroscopic comparison of the natural fluorites from Weardale with synthetic ones in which traces of rare earths and of Mn were incorporated has shown that the Weardale fluorite owes its fluorescence to the presence of Eu and of Yb. The blue fluorescent Weardale fluorite contains Eu and Yb, while the yellow green fluorescent samples contain

Yb and Y. In the fluorite from Wilberforce Mn was found but no rare earths. J. E.

2862. Fluorescence of Methyl Acridone. Influence of Electrical Atomic Fields. A. Schöntag and H. Fischer. *Zeits. f. phys. Chem.* 39. *Abt.B.* 5–6. *pp.* 411–430, 1938.—The dependence of the fluorescence of methyl acridone on the pH of the solution is investigated at ordinary and very low temperatures. Displacements of the band are attributed to the electric fields of H ions. Formation of a molecular hydrochloride is shown to be unlikely. At − 195° C., the fluorescence spectrum contains structure, which cannot be vibrational, and which is attributed to a lattice structure, so that it forms an expression for the restricted movement of the atomic fields of force building up the potential diagram of the fluorescing electron. A mechanism for fluorescence and phosphorescence in methyl acridone is proposed. C. B. A.

2863. Inorganic Phosphors without Metallic Activator. W. H. Byler. *Am. Chem. Soc., J.* 60. *pp.* 1247–1251, *May*, 1938.—Phosphors have been made from a number of inorganic compounds and mixtures without use of metallic activators. The case of the calcium phosphates has been considered in detail. Whereas the pure basic phosphate and acid phosphate show fluorescent intensities of 2 and 3 on an arbitrary scale after optimum heat treatment at 400°, a proper mixture of the two develops an intensity of 10 when similarly treated. Phosphors developed from mixtures of calcium phosphate with certain organic compounds have been studied in the light of results from the purely inorganic cases. These experiments have led to the general conclusion that, in the absence of a specific metallic activator, fluorescence resulting from heat treatment of inorganic compounds is due to formation of complexes of critical composition through partial decomposition or of critical physical condition through modification of crystal structure. AUTHOR.

2864. Chemiluminescence of a 3-Amino-phthalic Hydrazide. B. J. Svešnikov. *Acta Physicochimica*, 8. 4. *pp.* 441–460, 1938. *In English.*—Experiments are described on the way in which the intensity, time decay and relative efficiency of the chemiluminescence of the oxidation of 3-amino-phthalic-hydrazide by H_2O_2 in alkaline solution depends on temperature and on concentration of the three reactants. Possible mechanisms are discussed and the scheme favoured is that the luminescence accompanies the oxidation of a hydrolysed product of the hydrazide by an intermediate product of the chain reaction of H_2O_2 decomposition. J. E.

INTERFERENCE, DIFFRACTION AND SCATTERING.

***2865. Microscopic Examination of Ruled Gratings with Periodic Ruling Faults. H. F. W. Siedentopf.** *Zeits. f. Physik*, 109. 3–4. *pp.* 260–272, 1938.—In continuation of previous investigations [see Abstract 1996 (1938)] errors introduced by wrong focusing of the microscrope during examination of the grating rulings near the limit of resolving power are described. It is shown how this limit can be more nearly obtained by rotating the slit of the microscope used, and that periodic ruling errors in the grating can be detected from periodic image "repetitions." C. B. A.

2866. Rayleigh Scattering in Liquids. P. Peyrot. *Ann. de Physique*, 9. *pp.* 335–407, *March*, 1938.—Experimental observations are reported on the scattering of light of unmodified frequency in 40 liquids.

The first part of the paper is taken up with a critical discussion of the measurement of the depolarisation of the scattered light, and the method chosen by the author is described in detail. Ways are indicated of avoiding the chief sources of error: dust, Raman scattering, and particularly fluorescence. If this is due to impurity, it can usually be eliminated by distillation *in vacuo*, being careful to avoid vigorous boiling. In some cases, it appears to be a molecular property, and then its effects can only be circumvented by the use of suitable optical filters. Apart from water, all the substances studied were organic liquids. From the depolarisation factors, qualitative conclusions are drawn as to the optical anisotropics of the molecules. The aromatic liquids have a very high anisotropy. In the aliphatic substances the depolarisation ratio increases with the number of double bonds. The second part is devoted to the relative intensities of the scattered light for different liquids, taking benzene as a standard liquid. The aromatics scatter vigorously, and the aliphatics scatter feebly, but more strongly the greater the number of C atoms in a chain. The third part deals with the absolute intensity of the light scattered by benzene, and from the second part, the absolute intensities can be calculated for the liquids dealt with there. A. C. M.

2867. Scattering of Light. H. Mueller. *Roy. Soc., Proc.* 166*A*. *pp*. 425–449, *June* 3, 1938.—The Krishnan and Mie effects are discussed at length, and it is concluded (*a*) that every substance showing a Krishnan effect should show a Mie effect, (*b*) that the reciprocity relation is always valid. Both effects are related to the photoelastic properties in the case of solids, and to the constants of streaming birefringence in the case of liquids. Both effects must occur for temperature scattering in the case of solids, whilst the Krishnan effect can also occur in ordinary liquids. For temperature scattering the depolarisation $\rho_h = v_h/H_h$ is always larger than 1. A new theory of the scattering of light in glasses is proposed based on the assumption that glasses contain a random distribution of "frozen in" strains. Slightly below the solidification temperature these strains are normal ones, but at lower temperatures shearing strains are created due to temperature contraction. ρ_h is smaller than 1 because the shearing strains are always smaller than the normal strains. Krishnan's data are in excellent agreement with those calculated for glasses for which the photoelastic constants are known. Liquids with molecular clusters can be treated as if they were uniform liquids with a distribution of internal strains. They show $\rho_h < 1$ because the strains are predominantly normal ones. Finally, it is pointed out that scattering data can be used to determine the size of molecular clusters and of colloidal particles. A. H.

See also Abstracts 2873, 2960, 2961, 2962.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

2868. Photochemical Formation of Phosgene. Part X. W. Franke and H. J. Schumacher. Part XI. M. Bodenstein, W. Brenschede and H. J. Schumacher. *Zeits. f. phys. Chem.* 40. *Abt. B.* 1–2, *pp*. 115–134, 1938.—In Part X the photochemical formation of CO_2 from CO and O_2 sensitised by Cl_2 has been studied at pressures of 10–100 mm. In this range, as at higher pressures, the reaction velocity is proportional to the square root of the CO pressure. In Part XI the velocity and equilibrium constants of the partial reactions comprised in the photochemical and thermal formation of $COCl_2$, and in its thermal decomposition are calculated from previous work. [For Part IX see Abstract 3053 (1937).] A. J. M.

2869. Photosensitivity of Diphenylamine-*p*-Diazonium Sulphate by the Method of Photometric Curves. C. F. Goodeve and L. J. Wood. *Roy. Soc., Proc.* 166*A*. *pp*. 342–353, *June* 3, 1938.—The method of photometric curves, used previously to measure the photosensitivity of visual purple solutions, has been applied to the bleaching of diphenylamine-*p*-diazonium sulphate. The diazonium salt was bleached with light of wave-length 365 mμ, and it was found to have a quantum efficiency of $0 \cdot 34 \pm 0 \cdot 02$, independent of concentration and temperature. The photosensitivity was also found to be unaffected by the removal of dissolved O_2 and by the addition of an internal filter. These results have been compared with those obtained with visual purple, and their photochemical significance discussed. [See Abstract 744 (1938).] AUTHORS.

2870. Mechanism of Formation of HgH and HgD. Optical Excitation of CdD. L. O. Olsen. *J. Chem. Phys.* 6. *pp*. 307–310, *June*, 1938.—An attempt has been made to secure resonance excitation of HgH by illuminating (1) a mixture of Hg, H_2 and N_2, and (2) a mixture of Hg and H_2O, with the light from a Hg and H_2 discharge. This discharge emitted a fairly intense HgH spectrum. Weak HgH band radiation was observed which was similar to that secured when the same mixtures were illuminated with a discharge tube which did not emit the HgH radiation. Inability to secure resonance is evidence that the weak band radiation is due to HgH molecules formed in excited states which dissociate after emission. Experimental evidence is presented which indicates that the formation process is $Hg6^3P_1 + H \rightarrow HgH^2\pi_{1/2,\,3/2} + \Delta$, where Δ is an energy parameter. Essentially similar results were secured for HgD. Resonance excitation of CdD was observed when a mixture of Cd and D_2 was illuminated with a Cd and D_2 discharge. AUTHOR.

***2871. Electric Discharge Lamps and their Applications to Photography. N. L. Harris and H. J. A. Turner.** *Phot. J.* 78. *pp*. 401–414, *June*, 1938.—Of the various types of discharge lamp at present available, the 250-W and 400-W high-pressure mercury-vapour lamps share the greatest possibility of immediate application as photographic light sources. These lamps have a high-luminous efficiency and give greater speed with practically every type of photo-sensitive material than tungsten filament lamps. In most cases, they are less actinic than the carbon arc, but, on the other hand, they require little maintenance and can be used with simple, efficient fittings to give any desired distribution of light, at the same time forming a mechanically convenient lighting unit. The smaller, 125- and 80-W types are useful for enlargers and in other cases where a small lamp is required. In addition, they give greater speed with bromide papers. Luminescent high-pressure mercury-vapour lamps have been found to give good colour renderings and have a higher efficiency than tungsten filament lamps. Sodium lamps, although unsuitable where true colour renderings are required, have proved suitable for portrait photography. The high-pressure, high-brightness mercury vapour discharge, with its improved colour rendering properties, has possible future applications to projection work, both in the theatre and the studio. AUTHORS.

See also Abstracts 2875, 2878.

PHOTOMETRY.

***2872. Photoelectric Integrating Photometer. A. Blondel.** *Comptes Rendus*, 206. *pp.* 1231–1232, *April* 25, 1938.—Proposes the use of a large "lune" revolved about the vertical axis passing through the light source to be measured. This lune is covered with a photoelectric (rectifier type) surface so that the current is proportional to the flux falling on the lune. The mean value obtained during rotation (at a speed of a few r.p.s.) is proportional to the total flux from the source. Precautions necessary on account of (*a*) temperature effects, (*b*) inter-reflections and (*c*) colour correction are mentioned, but not non-linearity of the illumination/current curve. J. W. T. W.

See also Abstracts, 2879, 3036 and

2252B. Tests on Filament Projector Lamp. H. Pécheux.

POLARISATION.

2873. Anomalous Depolarisation of the Light Scattered by Binary Mixtures. B. K. Mookerjee. *Indian Journ. Phys.* 12. *pp.* 15–24, *March*, 1938.—The distribution of intensity in the "wing" of the Rayleigh line due to a binary mixture of CS_2 and CH_3OH at the critical solution temperature as well as the dependence of the value of ρ_h of the light scattered by a similar mixture of phenol and water on the shape of the illuminated volume have been experimentally investigated. The results do not seem to support the theory of formation of "clusters" put forward by Krishnan [see Abstract 4781 (1935).] AUTHOR.

***2874. Half-Shadow Polarimetry. R. Tsuchida.** *Chem. Soc., Japan, Bull.* 13. *pp.* 353–356, *April*, 1938. *In English.*—For measurements, with a half-shadow polarimeter, of the optical rotatory power at wave-lengths which are absorbed by the active substance, the optimum sensitivity is obtained when the half-shadow angle is $\frac{1}{2}(\epsilon_r - \epsilon_l)\,cd$ radians, where $(\epsilon_r - \epsilon_l)$ is the circular dichroism, and c and d are molar concentration of and length of optical path in the medium respectively. When $(\epsilon_r - \epsilon_l)$ is not known, the approximation $7 \cdot 5° \times (1 + \frac{1}{2}\epsilon cd)$ may be used, ϵ being the mean molar absorption coefficient. C. B. A.

2875. Theory of Photodichroism. S. Nikitine. *Comptes Rendus*, 206. *pp.* 1219–1222, *April* 20, 1938.—A theory previously developed [see Abstract 2569 (1937)] is extended to the case of molecules of coloured substances which pale or decolorise completely under irradiation, and formulæ are deduced by which the variation of the phenomenon can be calculated and compared with experiment. N. M. B.

***2876. Properties and Applications of Dichroic Sheet Polarisers. S. Rösch.** *Zeits. f. Instrumentenk.* 58. *pp.* 181–192, *May*, 1938.—After a brief review of the principal morphological features of the new thin film polarising materials, the optical properties are described. The transparency is of paramount importance and its variation with rotation of one element is studied. The application of these polarising films to photography, microscopy, interference filters and colour stereoprojection is described and illustrated. H. J. H. S.

2877. Absolute Configuration of Optically Active Substances. W. Kuhn. *Naturwiss.* 26. *pp.* 289–296, *May* 13, and *pp.* 305–310, *May* 20, 1938.—A review of work on the determination of the absolute configurations of optically active inorganic complexes (*e.g.*, potassium cobaltioxalate $[Co(ox)_3]K_3$) and organic compounds (*e.g.*, MeEtCHOH and substances related to it) based on the Cotton effect and absorption bands of the substances. A. J. M.

***2878. Motion Picture Polarigraph. W. M. Cohn.** *J.O.S.A.* 28. *pp.* 144–147, *May,* 1938.—An instrument has been developed for replacing visual measurements of polarisation, transmission, etc., by permanent records. A set-up is presented for determining the polarisation of sky light. AUTHOR.

***2879. Conversion of Polarisation Spectrophotometic Readings. L. Honty.** *Zeits. f. Instrumentenk.* 58. *pp.* 212–213, *May,* 1938.—It is often necessary to correct polarisation spectrophotometer readings for the so-called photometer constant which depends on the angular setting of the nicols and on the wave-length. A graphical method which saves much time and labour is described for carrying out these corrections and also for converting readings directly into optical density. H. J. H. S.

See also Abstracts 2914, 2960.

REFLECTION, REFRACTION AND DISPERSION.

2880. Freedom from Aberration with Individual Lenses. H. Schulz. *Zeits. f. Instrumentenk.* 58 *pp.* 167–168, *April,* 1938.—It has been shown that for a small number of single lenses the spherical aberration can be eliminated if the refractive index (n) exceeds a conditional limit for a given number of lenses. For four lenses a minimum value of $n = 1\cdot 55$ is incorrectly given. For this reason a basic equation is derived from the known Seidel formula and the limiting values of n are found for different numbers of lenses. R. S. R.

2881. U.V. Dispersion of Water between 6° and 35°. M. Bayen. *Comptes Rendus,* 206. *pp.* 1254–1256, *April* 25, 1938.—The dispersion was measured for λλ 2500–5893 between 17° and 35°, and for λλ 1930–2600 between 6° and 30°. Formulæ are given relating refraction with wave-length and with temperature separately, and with both simultaneously. The results differ slightly from those previously obtained by others, and the nature of the differences is discussed. [See Abstract 1185 (1936).] C. A. S.

SPECTROSCOPY.

***2882. Infra-Red Prism Spectroscopy. R. B. Barnes.** *J.O.S.A.* 28. *pp.* 140–143, *May,* 1938.—A discussion is given of the present existing limits of usefulness of the various prisms commonly employed in the infra-red. A new method for extending some of these limits is proposed. This method, based upon the disappearance of newly found secondary absorption maxima at low temperatures, would require that prisms of the alkali halides be used while cooled with liquid air. A possible spectrometer for this purpose is presented. Transmission curves for LiF crystals are given which show that a prism of this material would be useful to about 6μ. AUTHORS.

2883. Spectra of I II, I I, and Cl II. K. Murakawa. *Zeits. f. Physik,* 109. 3–4. *pp.* 162–174, 1938.—A number of lines in the I II spectrum are given a new classification and several new terms are identified. The hyperfine structure of several lines suggests a nuclear spin of 5/2. Some terms show deviations from the interval rule. Almost all strong lines of I I in the visible could be classified. In Cl II three terms have been identified. R. P.

2884. Spectrum of Fe II. J. C. Dobbie. *Solar Phys. Obs., Cambridge, Ann.* 5.1. *pp.* 1–58, 1938.—The Fe arc spectrum in the region 2150 to 9000Å is photographed in the 1st order of a 21 ft. Rowland grating in order to measure the lines appearing most strongly at the pole of the arc which belong to the Fe II spectrum. The purest Fe obtainable was used and with a 3·0-A 1·0 mm. arc exposures varied from 1/2 to 4 hr. The results are presented in 3 tables and a map of the spectrum from 2200–6000Å is reproduced in 4 plates. Table I gives a list of the known Fe II term values including the new terms discovered and previously reported by the author from these same photographs [see Abstract 4579 (1935)]. Table II comprises a list of the wave-lengths of Fe II lines from 2150 to 6627Å together with visual intensity estimates, observed and computed wave-numbers and term classifications. In Table III a list is given of the more important lines that are covered by Fe I lines or are not observed at all. Attention is drawn to the anomalous intensities in several multiplets. J. E. K.

2885. Effect of Gases on Width and Position of Spectral Lines. P. Schulz. *Phys. Zeits.* 39. *pp.* 412–429, *May* 15, 1938.—The theory of the broadening of spectral lines is reviewed and developed with special reference to the influence of foreign gases. The pressure effect in a homogeneous gas, and broadening by electrons and ions, are also considered. C. B. A.

2886. Nuclear Moment of Al. M. Heyden and R. Ritschl. *Zeits. f. Physik,* 108. 11–12. *pp.* 739–747, 1938.—The nuclear moment of Al has been given as I = 1/2 by Ritschl and as I = 5/2 by Jackson and Kuhn [see Abstract 722 (1938)]. In order to clear up this discrepancy the hyperfine structures of six Al II lines are investigated and the nuclear moment is determined by application of the Landé interval rule. The mechanical nuclear moment is found this time to be I = 5/2 and the magnetic moment $\mu = 3\cdot7$ nuclear magnetons. The possibility of departures from the interval rule existing in the case of the terms of Al II in question is discussed but it is concluded that the interval rule is most probably strictly applicable and that the value I = 5/2 must be regarded as established. It is suggested that the measurements of intensity of components by Jackson and Kuhn may have given rise to an incorrect value of I on account of the overlapping of imperfectly resolved components. J. E. K.

2887. Excited States of the H^3 and He^4 Nuclei. S. S. Share. *Phys. Rev.* 53. *pp.* 875–879, *June* 1, 1938.—Calculations were made with trial wave functions corresponding to such excited states of H^3 and He^4 which, in the Hartree approximation, would contain one or two particles excited into the *p* shell. If only one particle is excited there is no state which would be completely symmetrical in space coordinates and if two particles are excited only an *S* and a *D* state have this property. On account of the supposed predominance of the Majorana exchange forces in the nuclear Hamiltonian, these should be the lowest excited states in H^3 while in He^4 the *P* state in which only one particle would be excited in the Hartree picture lies close to these. No stable excited states are indicated for either of the nuclei when the forces are of the exchange type unless the range of force is much greater than the accepted range. Several improved forms of the *D* state wave function were tried but they failed to lower the energy sufficiently to make the states stable. AUTHOR.

2888. Low Terms in Co VI. I. S. Bowen. *Phys. Rev.* 53. *pp.* 889–890, *June* 1, 1938.—The present paper reports a continuation [see Abstract 204 (1938)] of the investigation of the low metastable terms in the high stages of ionisation of the elements of the first long period. A table is given of the classification of about 100 lines representing transitions between terms of the d^4 and d^34p configurations and another table gives the positions of 44 of these terms. This completes the location of the more important low terms of this isoelectronic sequence up to Co VI. In the ions of the VII and somewhat higher stages of ionisation of this row of the periodic table the terms of the $3s^23p^63d^{n-1}4p$ configuration become mixed with and distorted by the terms of the $3s^23p^53d^{n+1}$ configuration. This renders the study of these isoelectronic sequences beyond the VI stage difficult and uncertain. AUTHOR.

2889. Far Infra-Red Absorption of Atmospheric Water Vapour. W. M. Elsasser. *Astrophys. J.* 87. *pp.* 497–507, *June*, 1938.—The rotational spectrum of water vapour has recently been spectroscopically resolved and analysed by Randall, Dennison, Ginsburg and Weber [see Abstract 4525 (1937)]. The present determination of the absorption of water vapour under atmospheric conditions is based upon the results of these authors. Their line intensities have been used, and the mean absorption of the rotational band has been calculated for a temperature range from 200° Abs. to 320° Abs. The half-width has been estimated as 0·50 cm^{-1}. from the available information about the width of infra-red band lines. The absorption intensity at the short-wave side of the band decreases in the mean exponentially, as might be expected on general grounds. For waves shorter than 33μ the mean fraction of radiation absorbed can be expressed by the formula $A = 10^{ap+b} \cdot \sqrt{p/p_0} \cdot \sqrt{x}$ where p is the air pressure, p_0 the standard pressure, and x the thickness of the layer in grammes of water per cm^2.; a is a linear function of the temperature For longer waves the absorption is sensibly independent of wave length and temperature. The numerical values are collected in formulæ. AUTHOR.

2890. Franck-Condon Principle. A. Jabłoński. *Acta Physica Polonica*, 6. 4. *pp.* 350–355, 1937. *In German.*—The possibility of testing the validity of certain aspects of the Franck-Condon principle by measurements of the intensities of the absorption lines of diatomic molecules is discussed. An experimental proof of the complete theory is probably very difficult. J. S. G. T.

2891. Higher Harmonics in the Near Infra-Red of the Vibration of the C-H Linkage. A. Carrelli and P. Tulipano. *N. Cimento*, 15. *pp.* 1–4, *Jan.*, 1938.—The positions of a number of bands in the absorption spectra of $CHCl_3$, $CHBr_3$ and C_6H_6 in the photographic infra-red were determined. Two bands given by both the aliphatic compounds also appear, slightly displaced, with benzene and are identified with higher harmonics of the fundamental vibration associated with the linkage C–H. Another band lying between these two appears for $CHBr_3$ but not for C_6H_6. W. S. S.

2892. Infra-Red Absorption Spectra and Hydrogen Bridges. Part I. Near Infra-Red Spectra of Inorganic Oxyacids. T. Sidei and K. Imahori. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 304–311, *April*, 1938. *In English.*—The near infra-red absorption spectrum of H_2SO_4 at various concentrations and temperatures together with some preliminary accounts for HNO_3 are presented in this paper. In the case of H_2SO_4 at room-temperature a broad band with a maximum at $1 \cdot 81\mu$ is observed. It is attributed to the vibration characteristic of the motion of H against O in the acid OH group. A similar band is observed in acid solutions. When temperature is increased the band at $1 \cdot 81\mu$ is weakened in its intensity and a new band at $1 \cdot 5\mu$ which is in the overtone region characteristic of the OH radical appears increasing its intensity with temperature. For fuming H_2SO_4 and fuming HNO_3 at room-temperature the characteristic OH absorption bands lie at $1 \cdot 51\mu$ and $1 \cdot 55\mu$ respectively. From these facts the structure of these acids and their solutions together with the nature of the H bond are discussed. AUTHORS.

2893. Spectrum of Thallium Chloride. H. G. Howell and N. Coulson. *Roy. Soc., Proc.* 166*A*. *pp.* 238–249, *May* 19, 1938.—The spectrum of TlCl was studied in absorption and in emission by means of a h.f. discharge. Continua and diffuse bands together with a discrete band system were found in absorption in the region 2500–3500Å. The band system also occurs in emission and classified data are tabulated. The transition is probably $1 \rightleftarrows {}^1\Sigma^+$; constants for levels are evaluated and a vibrational analysis is given. Predissociation occurs in the band system and is probably responsible for the band intensities being the same in emission and in absorption. An attempt is made to identify the electronic levels of TlCl based on the similarity of the spectrum to that of TlF [see Abstract 2618 (1937)]. There was no sign of the ^{203}Tl isotope, but the Cl isotope effect completely supports the analysis given.

N. M. B.

2894. Band Spectra of SrCl and SrH. K. R. More and S. D. Cornell. *Phys. Rev.* 53. *pp.* 806–811, *May* 15, 1938.—The spectra of SrCl and SrH are observed in absorption. The SrCl analysis given by Parker is confirmed. Measurement of the relative intensities of corresponding bands of the electronic doublet $^2\Pi \rightarrow {}^2\Sigma$ indicates that $^2\Sigma$ is the ground state. Rotational analyses of several bands of the C and D systems of SrH lead to values of B_e of $4 \cdot 008$ and $1 \cdot 925$ for the C and D states, respectively. Vibrational analyses of the two systems give $\omega_e = 1206 \cdot 2$, $x_e\omega_e = 17 \cdot 0$ for the $X^2\Sigma$ state; $\omega_e = 1347$, $x_ew_e = 23 \cdot 5$ for the $C^2\Sigma$ state and $\omega_e = 1014 \cdot 1$ and $x_e\omega_e = 15 \cdot 4$ for the $D^2\Sigma$ state. The perturbations in the C and D states are discussed in terms of the interactions of the C, D and E states. AUTHORS.

2895. Infra-Red Absorption Bands in the Spectrum of Deutero-Formaldehyde. E. S. Ebers and H. H. Nielsen. *J. Chem. Phys.* 6. *pp.* 311–315, *June*, 1938.—The spectrum of D_2CO in the infra-red has been studied from $2 \cdot 0\mu$ to $13 \cdot 0\mu$ and seven absorption bands have been found. With these data and the data on the spectrum of H_2CO available it has been possible, making use of the product relations of Redlich, to identify with considerable certainty the fundamental frequencies of the H_2CO and D_2CO molecules, respectively, as: $\nu_1 = 2780$ cm^{-1}., $\nu_2 = 1750$ cm^{-1}., $\nu_3 = 2875$ cm^{-1}., $\nu_4 = 1503$ cm^{-1}., $\nu_5 = 1278$ cm^{-1}., $\nu_6 = 1165$ cm^{-1}., and $\nu_1' = 2056 \cdot 4$ cm^{-1}., $\nu_2' = 1700$ cm^{-1}., $\nu_3' = 2160 \cdot 3$ cm^{-1}., $\nu_4' = 1106 \cdot 4$ cm^{-1}., $\nu_5' = 990 \cdot 2$ cm^{-1} and $\nu_6' = 938 \cdot 0$ cm^{-1}. With this identification the valence force constants for the formaldehyde molecules have been computed. AUTHORS.

2896. Absorption Spectrum of Cæsium Hydride. G. M. Almy and M. Rassweiler. *Phys. Rev.* 53. *pp.* 890–894, *June* 1, 1938.—

V.
19

A ${}^1\Sigma \rightarrow {}^1\Sigma$ molecular spectrum of CsH has been photographed in absorption with a 3m. glass prism spectrograph. The spectrum is of the many lines type and the observed part lies between 4550 and 6250 Å. In the longer wave-lengths the bands are masked by a system of Cs_2 bands. The CsH system consists of 31 two-branch bands falling into three v' progressions. There is an additive uncertainty in the v'-numbering. The rotational and vibrational constants have been calculated for two electronic states. B_e' and $\Delta G'$ show the anomaly characteristic of alkali hydrides, rising with increasing v' to a maximum and then falling off. The heats of dissociation are 1·10 and 1·96 volts for the excited and ground states. Potential energy curves are drawn and it is shown that Mulliken's explanation for the anomalous behaviour of the excited states of alkali hydrides fits nicely in the case of CsH. AUTHORS.

2897. Emission Bands of $SiCl_2$ and $SnCl_2$. R. K. Asundi, M. Karim and R. Samuel. *Phys. Soc., Proc.* 50. *pp.* 581–598, *July* 1, 1938. —The discharge through flowing vapour of $SiCl_4$, $SnCl_4$ and $SnCl_2$ shows a number of regions of selective continuous emission, and, intimately connected with them, several sets of new bands. These appear under conditions unfavourable for the production of the known bands of SiCl and SnCl respectively. They are broad and diffuse, and have not the appearance of bands due to a diatomic emitter of low molecular weight. They are quite different from the known SiCl and SnCl bands as far as the anharmonic factor of the ground level of the molecule is concerned. They are therefore attributed to the triatomic molecules $SiCl_2$ and $SnCl_2$ respectively. An analysis carried out on this assumption reveals two excited electronic levels of $SiCl_2$($\nu\nu$ = 28295 and 29952), and one of $SnCl_2$ (ν = 22237). The presence of the deforming (breathing) vibration ω_1, and of the symmetrical valence vibration ω_2 are indicated both in the ground state and in the various excited states. The antisymmetric valance vibration is absent, in agreement with Herzberg-Teller's solution rules. For certain reasons ω_2' is smaller than ω_2'', despite ω' being larger than ω'' in the corresponding excited terms of SiCl and SnCl. The energies of excitation and the values of ω_2'' of $SiCl_2$ and $SnCl_2$ show a close similarity to the corresponding constants of SiCl and SnCl respectively, and also the bond energies appear to be rather unaffected by the transition from the diatomic to the triatomic molecule. The later ones appear to be triangular. AUTHORS.

2898. Predissociation of Sulphur. W. Lochte-Holtgreven. *Zeits. f. Physik,* 109. 1–2. *pp.* 147–149, 1938.—E. Olsson [see Abstract 1200 (1938)] reported observations of the predissociation of S_2 which differed from observations by the author [see Abstract 241 (1937)] and which were stated as destroying the experimental basis on which the latter's theoretical considerations as to the predissociation of S_2 were based. Lochte-Holtgreven takes exception to Olsson's suggestion, shows that Olsson's experimental results are not necessarily in conflict with his own, and points out that they in no way tend to disprove his discovery that the two dissociation regions in the S_2 spectrum behave in radically different manner at extremely low S_2 vapour pressures. In reply **E. Olsson** [*ibid. p.* 149] points out that Lochte-Holtgreven's reconciliation of the two sets of experimental observations is based on the supposition that Olsson worked at effectively higher S_2 vapour pressure than Lochte-Holtgreven, whereas from a study of the experimental conditions Olsson believes the reverse to have been the case. J. E. K.

2899. Line Width in HCN Bands. E. Lindholm. *Zeits. f. Physik*, 109. 3–4. *pp.* 223–235, 1938.—The half-widths of lines in the rotation-vibration bands of HCN in the photographic infra-red are found to show strong J-dependence. Observed values are compared with expressions derived theoretically, for which purpose HCN is treated as a mixture of gases, each of which is characterised by a definite quantum state J and the dependent optical width, and the collision damping formula is generalised for such a mixture. It is then combined with London's formula for intermolecular forces. Account is taken of the influence of the excited vibration states. The J-dependent line broadening depends considerably on resonance between neighbouring rotational states (" rotational resonance"), which is different from the resonance usually considered. C. B. A.

2900. Attribution of Band Lines to Causes other than Rotation. H. Deslandres. *Comptes Rendus*, 206. *pp.* 1424–1428, *May* 16, 1938.—Recently measured lines in the spectrum of water are arranged according to the ideas of previous papers [see Abstracts 1211 and 2469 (1938)] in nine series. Lines are attributed to H_2O, H_4O_2 and H_2O_2. **Errata,** *ibid. f.* 1932, *June* 20, 1938. H. G. C.

2901. Spectroscopy and Valency. Part VI. R. W. Berriman and C. H. D. Clark. *Leeds Philosoph. and Lit. Soc., Proc.* 3. *pp.* 465–476, *April*, 1938.—The periodicity of spectroscopic numbers is extended to include bonding energy (heat of dissociation) of hydride di-atoms. The principle is used to " weight " the values recorded by different authors. Bonding energies are also calculated by thermal methods, the following being recorded for the first time: Si–H 3·27, S–H 3·80, As–H 2·06, Se–H 3·18, Te–H 2·70 and Sb–H 1·6 (estimated) electron-volts. The spectroscopic and thermochemical bonding energies are compared and discussed, and it is shown that the apparently abnormally high value for thermal CH derived from CH_4 may be accounted for in terms of the excitation energy of carbon from the ground ^3P to the excited ^5S state. Other small deviations exist which cannot be explained on excitation grounds, but these exhibit characteristic and periodic regularities, so that they do not appear to be due to experimental error. The thermal bonding energy of C–C, deduced from Herzberg's calculation of the heat of sublimation of solid C, in conjunction with Rossini's empirical rule, appears to be equal to that of C–H and C–C in long-chain *n*-paraffins having more than 5 C atoms (4·82 eV) within about 0·02 eV. This suggests that the stability of such long chains may be associated with each C atom being surrounded by a force-field of a type similar to that of a C atom in diamond. The departures from additivity increase regularly in the series of thermal values from CH to FH with increasing polar opposition of the two atoms concerned. [For Part V. see Abstract 2740 (1936).] AUTHORS.

2902. Spectrum of a Diatomic Molecule and the Calculation of the Dissociation Energy. S. K. Chakravorti. *Zeits. f. Physik*, 109. 1–2. *pp.* 25–38, 1938.—A particular kind of perturbation theory is applied to the problem of vibrations and rotations of a molecule and an approximate method calculating the heat of dissociation from the constants of the spectrum is developed. The method is applied to BeH, CdH, C_2 and N_2, with satisfactory results. R. P.

***2903. Comparison of Intensities of Spectral Lines with a Total Radiation Source. T. N. Panay.** *Ann. de Physique*, 9. *pp.* 408–476, *March*, 1938.—An apparatus is described which conveniently emits total radiation at several temperatures. This is used as a standard source with which to compare the intensities of spectral lines. The black body consists of a carbon tube, electrically heated, the radiation escaping by a small hole in the wall. The tube is contained in a pyrex envelope, in which A circulates. The secondary of a transformer supplies the current to the tube; instead of it having to pass through the pyrex envelope the latter covers the secondary as well. This is achieved by fusing a helical pyrex tube on to the envelope at each end, and then forming the secondary by coaxing pliable Cu wire round inside the helix to form the secondary. A great convenience of the total radiation standard is that it can be run at different intensities by varying the temperature, instead of having a fixed intensity standard, and having to weaken the intensity greatly by introducing strongly absorbing screens when weak lines have to be measured. Measurements at fixed temperatures were made by using, for example, Zn boiling under atmospheric pressure. The apparatus was used to investigate the continuous spectrum of K in the flame. A. C. M.

2904. Kathodoluminescence Spectrum Due to the Presence of Samarium in Solid Calcium Compounds. E. Iwase. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 783. *pp.* 487–503, *May*, 1938. *In English.*—Kathodoluminescence spectra were investigated on the following nine Ca compounds containing Sm: silicate, sulphate, phosphate, tungstate, molybdate, fluoride, oxide, aluminate, and borate. In the luminescence spectra exhibited by several Ca minerals from Japan, such as scheelite from Kurasawa, fluorite from Hirukawa, apatite from Kurokura, and danburite from Obira, Sm bands were identified by employing the spectroscopical data here obtained. AUTHOR.

2905. Frequency and Polarisation of Stark Effect Components. R. Gebauer. *Zeits. f. Physik,* 109. 1–2. *pp.* 85–107, 1938.—The separation and polarisation of the Stark effect components of H_β and H_γ with sudden changes in the field conditions were investigated with Heisenberg's theory in view. According to this, the duration of the Stark effect periods should give a lower limit for the observability of the effect. Observations show that the limit can be reached but cannot be reduced. F. S.

***2906. Intensity Relations of Stark Components in Hydrogen. N. Ryde.** *Zeits. f. Physik,* 109. 1–2. *pp.* 108–120, 1938.—A new discharge tube is described in which fields of 500 kV/cm. can be used. The intensity dissymmetry of H_β and D_β was examined while keeping one of the excitation conditions constant and was found to vary in magnitude and direction. The observations agree with Gustafson's calculation to a first approximation. Conclusions are drawn regarding the distribution of atoms in the various Stark effect levels. F. S.

2907. Raman Spectra of Water-Ethyl Alcohol Mixtures. F. Cennamo. *N. Cimento,* 15. *pp.* 10–13, *Jan.*, 1938.—Researches on the Raman spectrum of water in the liquid state have not yet permitted definite conclusions to be made as to the classification of the various frequencies observed. Previous experimental contributions have been made to the problem of classification by a study of the effects of sulphates and chlorides in solution on the water bands. Observations are now extended to water-ethyl alcohol mixtures. Microphotometer traces show that the band at 3400 cm^{-1}. is modified in the mixture; the two bands with $\Delta\nu = 3200 cm^{-1}$. and $\Delta\nu = 3450 cm^{-1}$. are more clearly distinguishable. The presence of the dipole has the effect of diminishing the intensity of the band with

$\Delta\nu = 3620$, the band which most authors have attributed to the simple molecule. C. J. B. C.

2908. Raman Effect in Boric Acid and Boron Compounds. S. M. Mitra. *Indian Journ. Phys.* 12. *pp.* 9–14, *March*, 1938.—The paper gives the results obtained from the author's investigations on the Raman effect in boric acid and other borates. In the case of the boric acid solution the frequencies 515, 872 and 986 cm^{-1}. and in the case of the solid powder the frequency 882 cm^{-1}. in addition of the two broad lines at 3195 and 3290 cm^{-1}. due to the vibrations of O-H, were observed. Presumably therefore the molecule $B(OH)_3$ has a symmetry D_{3h}. The results obtained in the case of methyl borate, ethyl borate and butyl borate are also included in the report. AUTHOR.

2909. Origin of New Raman Lines Due to Molecules in the Solid State and of the "Wing" Due to Liquids. S. C. Sirkar and J. Gupta. *Indian Journ. Phys.* 12. *pp.* 35–46, *March*, 1938.—Further investigations on the origin of the new Raman lines in the low frequency region in the case of some organic crystals are reported and these results as well as those observed previously are discussed in detail. The present investigations consist in the study of (1) the directions of extinctions in a single crystal of *p*-dichlorobenzene at room-temperature and below 12° C. with the rays parallel to the "b" axis and of (2) the Raman spectra of polycrystalline masses of toluene, dichloroethylene (*cis* and *trans*), ethylene dichloride and xylene at the temperature of liquid O_2. It is observed that the directions of extinctions remain respectively parallel and perpendicular to the *a* axis at both the temperatures. This fact disproves the hypothesis put forward by Vuks that the orientation of the molecules changes with temperature. The results of the study of the Raman spectra show that intense new Raman lines are observed in the case of the centro-symmetrical molecules in the solid state but no such lines are observed with any appreciable intensity in the case of solid toluene, although, as this molecule has no centre of symmetry, the restoring force is asymmetric during lattice oscillation. From these results it is concluded that the new lines are not due to lattice oscillations. As regards the conclusion arrived at by other workers that the "wing" due to liquids and the new Raman lines mentioned above have the same origin, *viz.*, lattice oscillations, it is pointed out that observed facts do not support such a conclusion, because the large aggregate intensity of the wing, the distribution of intensity in it and also the extent of the wing cannot be explained by assuming that the new lines observed in the solid state spread out to produce the wing in the liquid state. AUTHORS.

2910. Fine Structure of Raman Lines in Benzene and Benzene-d_6. A. Langseth and R. C. Lord, Jr. *J. Chem. Phys.* 6. *pp.* 203–204, *April*, 1938.—Cheng, Hsueh, and Wu have investigated the fine structure of the 992 cm^{-1}. line in benzene [see Abstract 729 (1938)]. This has impelled the authors to give an advance account of their investigations, with regard to this line and its counterpart in benzene-d_6. They regard the components I and IV as due to transitions from the first excited state of the Eg^+ vibration ν_6 to the two levels of the resonance doublet $Eg^+ : Alg + Eg^+$ $(\nu_8 = \nu_1 + \nu_6)$. Two others, II and V, are two totally symmetrical lines of the molecule $C^{12}_5 C^{13} H_6$ derived from the frequencies ν_1 and ν_{12} in benzene. Reasons are given for these allocations, based on frequencies and intensities. The fine-structure obtained by the authors for the 945 cm^{-1}. line of benzene-d_6 is published; they find the components, 939·5, 945·2, and 962·1 cm^{-1}. A. C. M.

2911. Raman Spectra of Deutero-Ethylenes. M. de Hemptinne, J. Jungers and J. M. Delfosse. *J. Chem. Phys.* 6. *pp.* 319–324, *June*, 1938.—All the different ethylenes have been prepared and their Raman spectra in the liquid state measured and classified. A comparison between experimental data and theoretical predictions permits an estimate of the order of magnitude of the anharmonicity. AUTHORS.

2912. Raman Effect in Solid Cyclohexane. S. M. Mitra. *Phil. Mag.* 25. *pp.* 895–899, *June*, 1938. *Supplement.*—The paper describes the results obtained in the author's investigation on the Raman effect in solid cyclohexane. Each of the lines at 1266, 1437 cm^{-1}. in the case of liquid seems to split up into two in the case of the solid. The line at $\Delta\nu = 2922$ cm^{-1}. broadens, and the other lines found in the case of the liquid appear more or less in the same positions. Two new lines of $\Delta\nu = 60$ and 105 cm^{-1}. also appear in the solid state. AUTHOR.

2913. Raman Effect of Methyl Derivatives. J. Wagner. *Zeits. f. phys. Chem.* 40. *Abt.B.* 1–2. *pp.* 36–50, 1938.—Treatment of methyl derivatives of the type X-CH_3 as valency-force systems gives results in agreement with experiment for the effect of varying the substituent X upon the Raman frequencies. It accounts for the constancy of three of the frequencies characteristic of the CH_3 group at approximately 3000, 2950 and 1430 cm^{-1}. Quantitative calculation of force constants is possible only for the methyl halides and the following values are obtained: C–H, 4·96; C–Cl, 3·34; C–Br, 2·76; C–I, 2·26 × 10^5 dynes/cm. In cases where the substituent X is not simple (X = CH_3, OH, SH, NH_2) an approximate method of calculation is adopted and the following values are derived: C–C, 4·95; C–N, 5·61; C–O, 5·73; C–S, 3·44 × 10^5 dynes/cm. L. A. W.

2914. Quantitative Investigations of the Polarisation of Raman Lines of Crystals. H. Michalke. *Zeits. f. Physik*, 108. 11–12. *pp.* 748–770, 1938.—A quantitative determination is made of the degree of polarisation and the intensity of Raman lines of calcspar, quartz and beryl for various crystal orientations. A special experimental arrangement is described which enables the state of polarisation of Raman lines of optically active substances to be determined; this arrangement is applied to the measurements on quartz with its axis in the direction of observation. Comparison of the results with Placzek's theory of the influence of crystal symmetry confirms the well known allocation of vibrations for calcspar; difficulties arise only in regard to the pulsation of the CO_3 group; these are discussed. In the case of quartz and beryl the allocation of vibrations is in agreement with the interpretation of the infra-red silicate spectrum by Schaefer, Matossi and Wirtz [see Abstract 3290 (1934)]. J. E. K.

See also Abstracts 2654, 2655, 2766, 2870, 2882, 2944.

TRANSMISSION.

2915. Measurement of the Second-Order Doppler Effect. O. Scherzer. *Ann. d. Physik*, 32. 3. *pp.* 242–244, *June*, 1938.—The dependence of the observed period of a vibrating body on its linear velocity is discussed. Special reference is made to radiation from canal rays, elimination of the ordinary Doppler effect being realised by observation perpendicular to the line of motion. A suitable experimental arrangement is suggested and indication is given of the phenomena to be expected. F. C. C.

X-RAYS.

2916. Experimental Verification of the Quantum-Mechanical Dispersion Theory by Reflection and Diffuse Scattering of X-Rays from Zinc. W. A. Bruce. *Phys. Rev.* 53. *pp.* 802–806, *May* 15, 1938.—Hönl used his dispersion theory to develop a formula for the X-ray scattering power of an atom for wave-lengths near the absorption edge. He expressed his formula as the difference Δf between his value and f calculated by some method such as that of Hartree. In this paper it is shown that the F values obtained in the powder crystal experiments of Brindley, Wollan and Harvey, and Miller may be used to verify this formula when they are corrected by the proper temperature factor given by recent experiments in diffuse scattering. The diffuse scattering experiment also gives f values which may be used to verify the Hönl theory. It is shown that all existing data on the f values of zinc are in good agreement when they have been corrected by the Jauncey and Bruce temperature factor and the Hönl Δf. A working formula for Hönl's Δf for any element and for any wave-length is given together with a table of theoretical values of Δf for zinc. From a consideration of all experimental results for zinc a set of f values has been constructed and these are given in a table. This table shows that there is electron distortion and reasons are advanced for believing that the distortion of the electron atmosphere extends deeper into the atom than the valence electrons. AUTHOR.

2917. State of Equilibrium between Large Ions and Ions Produced by X-Rays in a Gas. Ouang Te-Tchao and A. M. Moulin. *Comptes Rendus*, 206. *pp.* 1464–1466, *May* 16, 1938.—The equilibrium has been studied for large variations of the intensity of ionisation and it is found that the number of large ions is proportional to the number of neutral particles and in consequence to the concentration. Experimental details are briefly given, and an alternative method of measurement is described. [See also Abstract 2494 (1937).] H. H. Ho.

2918. Influence of Chemical Binding on X-Ray Absorption Spectra. R. Landshoff. *Rev. Sci. Instruments*, 9. *pp.* 143–147, *May* 1938.—The information as to the nature of chemical binding which may be obtained from X-ray absorption spectra is reviewed, more particularly the evidence to be derived from work on the fine structure of absorption edges. Krönig's theory of the fine structure of electronic states is discussed. Experiments on X-ray emission spectra show an influence of the state of binding of the atom or ion, but the theory of the effect has not been developed. C. J. B. C.

2919. Chemical Reactions of Organic Compounds with X-Ray Activated Water. H. Fricke, E. J. Hart and H. P. Smith. *J. Chem. Phys.* 6. *pp.* 229–240, *May*, 1938.—Gas-free solutions of CO, alcohol, aldehydes, ketones and acids were irradiated by X-rays in the concentration range $10 \mu M$ to $1 M$, between $pH = 1$ to 13, and the reactions studied by gas analysis and potentiometric acid analysis. Foreign organic matter must be excluded from the solutions, and the methods used to accomplish this are described. Organic compounds in water can be determined by irradiation of the water and measuring the H_2 and CO evolved. The results do not permit of brief abstraction, but oxidation and condensation reactions with the evolution of H_2 are important in the effect of the rays. CO_2 was produced from certain acids, particularly those having an O atom in the α-position. The effect of the rays depends on the H ion concentration, this factor affecting reaction rates as well as the nature of the reactions. The X-ray reactions are similar to, but generally more complex than, the reactions produced by water activated by light inside the absorption band at 1900 Å. C. J. B. C.

2920. Chemical Activity of Gas Ions : Decomposition of Azomethane under the Influence of X-Rays. P. Günther and H. Theobald. *Zeits, f. phys. Chem.* 40. *Abt.B.* 1–2. *pp.* 1–35, 1938.—Current theories concerning the chemical activity of gaseous ions are discussed. A description is given of experiments on the decomposition of azo-methane by irradiation with X-rays after sensitisation by the addition of xenon. It is found that 4 molecules of azo-methane decompose for each ion pair, this relation being to a great extent independent of the total pressure and the composition of the gas mixture. Only when the ratio of xenon to azo-methane exceeds 2·5 to 1 does the relative amount of decomposition fall off. The results are discussed and shown to lend no support to the "cluster" theory of Lind. L. A. W.

2921. Quantitative X-Ray Analysis. K. Schäfer. *Zeits. f. Krist.* 99. 2. *pp.* 142–152, 1938.—A method for the quantitative determination of the components of a crystalline mixture is described which depends on the measurement of the intensities of the X-ray reflections on a Debye-Scherrer diagram. Specimen results for mixtures of KBr–NaCl and of Cu–Al_2 alloy with Al are in excellent agreement with the known proportions of the constituents. C. J. B. C.

2922. Localisation of Objects by X-Rays. H. Steinhaus. *Comptes Rendus,* 206. *pp.* 1473–1475, *May* 16, 1938.—A device is described and figured for determining the exact position of a small object differently sensitive to X-rays from its surroundings, *e.g.*, of a particle of lead, buried in other material. The method can be adapted to the determination of the exact position in the body of a wound, bullet, etc. C. A. S.

2923. Suggestion for Development of Double-Crystal X-Ray Spectrometer. M. Renninger. *Zeits. f. Krist.* 99. 2. *pp.* 181–187, 1938.—The fundamental idea for a three-crystal X-ray spectrometer is developed, which should permit the determination of the form of the reflection curve of a single crystal for accurately monochromatic X-radiation. It consists in the use of a pair of sharply reflecting crystals in the (1, + 1) reflecting position, which gives a parallel, monochromatic beam for the study of the third crystal. The idea described here is substantially different from that proposed by du Mond. [See Abstract 5014 (1937).] C. J. B. C.

See also Abstracts 2660, 2665, 3031, 3032.

HEAT.

CALORIMETRY.

***2924. Low-Temperature Calorimeter. Heat Capacity and Entropy of Thallium from 14 to 300° K. J. F. G. Hicks, Jr.** *Am. Chem. Soc., J.* 60. *pp.* 1000–1004, *May,* 1938.—A calorimeter suitable for low-temperature heat capacity measurements is described and the method discussed. The heat capacity of Tl is determined from 14 to 300° K. and the entropy at 298·2° K. computed. It is 15·35 ± 0·05 e.u. Measurements on the heat capacity of naphthalene also are presented as a means of comparing this method with those of other investigators. A check calculation of the entropy of thallous ion is included, and found to agree with the previous value of 30·1 e.u. AUTHOR.

***2925. Diphenyl-Ether Calorimeter. T. Holmberg.** *Soc. Scien. Fennica, Comm. Phys.-Math.* 9. 17. [8*pp*.], 1938. *In German.*—A Bunsen calorimeter employing diphenyl-ether is described, and data regarding its sensitivity are given. It is claimed that diphenyl-ether is a suitable substance on account of its stability, melting point (27° C.) and volume change on melting. A technique for filling the calorimeter so that the working substance is free from air, and does not come in contact with tap grease or rubber, is described. L. G. C.

***2926. Experimental Investigation of Combustion Calorimeters. S. W. Lipin.** *Zeits. f. Instrumentenk.* 58. *pp.* 193–207, *May*, 1938.—As a result of an experimental investigation of four different types of combustion calorimeters it is concluded (1) that the cooling constant has not a fixed value but increases with the temperature difference between the calorimeter and the surroundings: (2) that for the same temperature difference between the calorimeter and the surroundings the value of the cooling constant, when the lid is not tightly closed, is greater when the temperature of the calorimeter exceeds that of the enclosure: (3) that the cooling constant is reduced when the water jacket is replaced by an air jacket: (4) that Jaeger and Steinwehr's and Landrieu's methods of determining the heat of stirring are subject to doubt in consequence of the dependence of the heat of evaporation on the stirring rate, and that Roesler's formula does not completely represent this correction. Stirring of the whirling type is found to give better temperature equality than either the propeller or ring type but produces more heating. Of the two latter the propeller stirrer is to be preferred. R. W. P.

See also Abstracts 2943, 2949.

CONDUCTION.

2927. Application of Fourier Analysis to Heat Flow in Complex Systems. P. Vernotte. *Comptes Rendus*, 206. *pp.* 1286–1288, *May* 2, 1938.—The limitations of Fourier analysis, particularly for small time intervals, are discussed for the case of heat flow in a number of superimposed media. Solutions can be obtained by similar methods to those recently described [see Abstract 2067 (1938)], and the nature of the results obtained is indicated for various combinations of insulating and conducting media. R. W. P.

2928. Thermal Conductivity of Fibreboard and Rock Wool. J. D. Babbitt. *Canad. J. of Research*, 16. *Sect. A. pp.* 82–87, *April*, 1938. The thermal conductivity of samples of rock wool and fibreboard of various thicknesses (0·5 to 2·0 in.) was measured by means of a hot-plate apparatus. It was found that when surface effects were eliminated the conductivity obeyed Fourier's law. AUTHOR.

***2929. Thermal Conductivity of Porcelain and Kieselguhr-Brick to 800° C. W. Koch.** *Phys. Zeits.* 39. *pp.* 431–436, *June* 1, 1938. —An apparatus of the horizontal plate type is described for the measurement of absolute thermal conductivities up to 800° C. The specimen is in the form of a square slab of 30 cm. side and 3 to 5 cm. thickness, a central square section of 10 cm. side being isolated from the main slab so that the outer portion serves as a guard ring. Below the specimen is an electrical plate heater extending to the edges, but in which energy given to the iso-

lated section can be measured independently. A second plate heater below this and separated by a poor conducting slab is provided to prevent downward heat loss. The whole upper surface of the test slab is either cooled by a water-flow unit, or heated electrically to a temperature below that of its lower surface. Fifteen thermocouples are incorporated in the apparatus to indicate the temperature difference between the hot and cold faces of the specimen, and the adjustments necessary to cause the whole of the measured energy to flow through its central section. The thermal conductivity of hard porcelain (density 2290 kg./m^3.) is found to increase linearly from 1·23 kg.cal./m.h.° C. at 55° C. to 1·57 at 744° C. The conductivity-temperature curve for kieselguhr brick (density 400 kg./m^3.) is convex to the temperature axis, values of 0·08, 0·107, 0·132 and 0·163 kg.cal./m.h° C. at 57, 312, 505 and 707° C. respectively being obtained.
R. W. P.

See also Abstracts 2793, 2934, 3042.

DILATATION.

***2930. Thermal Expansion of Metals. E. Rosenbohm.** *Physica,* 5. *pp.* 385–398, *May,* 1938. *In German.*—A short rod of the metal under test is positioned between two quartz rods one of which is fixed and the other is so arranged that any movement in a vertical direction opens or closes a slit. An image of an electric lamp filament is focused on the slit, which is itself so arranged that a reduced image is produced on the sensitive element of a Moll thermopile. The latter is connected to a double mirror Siemens galvanometer and the movement of the mirrors can be read on a ground glass scale or recorded photographically. The arrangement is such that an expansion of 0·0001 mm. is represented by at least 1 cm. on the scale. The whole is contained in a specially designed oven; the temperature of the specimen is obtained from two Pt-Pt. Rh thermocouples. Full details of the construction and use of the apparatus are given. The expansion coefficient of Cu is given by $A = 16{\cdot}26 \times 10^{-6} + 3{\cdot}912 \times 10^{-9}t$ and is in good agreement with the results of Uffelmann and Eucken. For Ni 0°–300° $10^6 A = 12{\cdot}37 + 1{\cdot}31 \times 10^{-2}t$ and from 300°–520° $10^6 A = 13{\cdot}94 + 5{\cdot}545 \times 10^{-3}t$, and this is shown graphically. E. H. D.

FUSION AND SOLIDIFICATION.

2931. Supercooling and Freezing of Water. N. E. Dorsey. *Bureau of Standards, J. of Research,* 20. *pp.* 799–808, *June,* 1938.—This is a strictly preliminary report, rendered necessary by a temporary suspension of the work. No doubt attaches to the observations reported, but the setting of limits within which they are valid, and the determining of the most satisfactory way in which to explain them, should await further work. Contrary to current opinions, it has been found that the extreme supercooling of water (at least down to − 21° C.) is not dependent upon either extreme quiescence or upon the use of a minute volume, and that motes in the water exert a strong non-specific effect. For each specimen there is a definite temperature (the spontaneous-freezing-point), characteristic of the specimen, at which ice suddenly appears, at which the water freezes spontaneously. The well-known fact that a preheating of the water may facilitate its supercooling has been found to depend upon a lasting change so produced in the water—a change that persists at room-temperatures for at least 6 months, and that seems to be permanent. By sedimentation, the

spontaneous-freezing-points of the extreme layers of a column of water become different, that of the bottom ones becoming higher than that of the top ones. All the observations are consistent, with the idea that the spontaneous-freezing-point of a specimen is determined, within undetermined limits, by the size of the largest mote that it contains ; the smaller the mote, the lower the spontaneous-freezing-point. The effect of agitation has been considered, and three distinct types of freezing have been recognised.
AUTHOR.

TEMPERATURE.

2932. Thermodynamic Scale below 1° K. W. Jacyna, L. Malis and A. Obnorsky. *Acad. Polonaise Sci. et Lettres, Bull.* 1–2*A*. *pp.* 33–36, *Jan.–Feb.*, 1938. *In French.*—The means available for the determination of temperatures very close to the absolute zero are the thermomagnetic method, which involves measurement of the susceptibility of a paramagnetic salt, or the direct application of the second law of thermodynamics. A modification of this latter method has recently been suggested by Kurti, Lainé and Simon [see Abstract 2173 (1937)]. A discussion of the problem follows, which points out possible disadvantages of each of these methods and which suggests that a method based directly on the equation of state of a thermometric body is desirable. R. W. P.

2933. Thermo-Electrolytic Temperature Measurements. S. Zamenhof. *Acta Physica Polonica*, 6. 4. *pp*. 346–349, 1937. *In English.*—The theoretical and practical possibilities of a system of temperature measurement based upon the e.m.f. developed when two exactly similar metal electrodes at different temperatures are immersed in a common electrolyte consisting of a solution of a salt of the metal, are studied. Results with Cu electrodes immersed in N$CuSO_4$ solution show that the method is 17–24 times as sensitive as the method using thermocouples, but errors as large as 10% are possible, due to concentration, polarisation effects and transport of electrolyte. J. S. G. T.

2934. Low-Temperature Researches. J. D. Cockcroft. *N. Cimento*, 15. *pp*. 35–40, *Jan.*, 1938. *In English.*—The method used at the Cavendish Laboratory for the production of liquid He is outlined, and a description is given of some of the low-temperature researches in progress. The thermal conductivity of liquid He II has been determined in capillary tubes of 0·54 and 1·45 mm. dia., using a differential helium vapour pressure thermometer to measure the temperature difference. At first the thermal conductivity was thought to increase with decreasing heat flow, but this effect is now attributed to the destruction of momentum associated with the heat flow. The adiabatic demagnetisation method for the production of very low temperatures requires the maintenance of high magnetic fields for several minutes. A magnet consisting of a water-cooled coil shrouded in iron has been designed for use in this connection. It is in the form of a short cylinder having an axial cavity, within which a field of 30,000 gauss is produced for a dissipation of 120 kW. R. W. P.

2935. Cooling by Adiabatic Demagnetisation. P. Debye. *Ann. d. Physik*, 32. 1–2. *pp*. 85–101, *May*, 1938.—The principles underlying the method of cooling by means of the adiabatic demagnetisation of a metallic salt are described, followed by a theoretical discussion of the magnetic and thermal properties at relatively high, moderate and low temperatures.
H. J. H. S.

***2936. Phosphor-Bronze Resistance Thermometers for the Temperature Region of Liquid Helium, Suitable for Use in Strong Magnetic Fields. P. H. van Laer and W. H. Keesom.** *K. Onnes Lab., Leiden, Comm. No.* 252f, *Physica,* 5. *pp.* 541–544, *June,* 1938.—In this paper a short account is given of experiments with phosphor-bronze as a material for resistance thermometers suitable for use in strong magnetic fields at liquid He temperatures. For magnetic fields up to 8000 gauss it is possible to use phosphor-bronze wires with a percentage of 0·05 or 0·1% of a Pb-Bi-alloy. For still stronger magnetic fields the percentage of the Pb-Bi-alloy must be higher (0·2 or 0·3%) so as to make the wires nearly supraconductive in zero magnetic field. AUTHORS.

***2937. Amorphous Carbon Resistance-Thermometer Heaters at Low Temperatures. W. F. Giauque, J. W. Stout and C. W. Clark.** *Am. Chem. Soc., J.* 60. *pp.* 1053–1060, *May,* 1938.—It has previously been shown that in an ideal paramagnetic system the adiabatic differential susceptibility is zero and further that at high magnetic fields it is zero for non-ideal systems. It cannot, therefore, be used for temperature measurements. The electrical resistance characteristics of amorphous C at low temperatures have been investigated and it is concluded that resistance-thermometer heaters of this material will be very useful at temperatures below 1° K. The construction and behaviour of several types of thermometer are given in some detail and also the properties of Pt films on glass were investigated. The resistance of a C thermometer has been determined from 293° to 0·129° K., and was 28,062 and 58,640 Ω respectively. The constancy of the calibration over long periods and through successive heatings and coolings has been found very satisfactory after the initial stabilisation has taken place. The increase of resistance with magnetic field has been investigated at 4·2° and 1·5° K., but is being further considered. E. H. D.

***2938. Simple Type of Helium Cryostat. J. G. Daunt and K. Mendelssohn.** *Phys. Soc., Proc.* 50. *pp.* 525–533, *July* 1, 1938.—Two simple cryostats for the temperature region of liquid He are described; they have been found to facilitate experiments in that region greatly, and were constructed with the aim of combining the advantages of a small liquefier with those of an ordinary helium cryostat. AUTHORS.

THERMOCHEMISTRY.

2939. Heats of Hydration and Transition of Calcium Sulphate. E. S. Newman and L. S. Wells. *Bureau of Standards, J. of Research,* 20. *pp.* 825–836, *June,* 1938.—The heats of solution at 25° C. in 2·09 molal HCl of gypsum, hemihydrate, natural anhydrite, and anhydrous $CaSO_4$, prepared by heating gypsum at various temperatures, have been determined. From these values the heats evolved in the hydration to gypsum of hemihydrate, and of anhydrite prepared at 1000° C., were calculated to be 4100 ± 30 and 3990 ± 20 cal./mole, respectively. The heat evolved in the hydration to gypsum of soluble anhydrite prepared by dehydrating gypsum at 75° C. is not less than 6990 cal./mole. In the course of this work X-ray and microscopic studies gave no indication of the existence of more than two forms of anhydrous calcium sulphate: soluble anhydrite and a modification formed rapidly at high temperatures, the latter being identical with natural anhydrite. The heat evolved in the transition of soluble anhydrite to natural anhydrite is not less than 3000 cal./mole. AUTHORS.

2940. Lattice Disturbances, Particle Size and Thermal Content of Pyrophoric Iron. R. Fricke, O. Lohrmann and W. Wolf. *Zeits. f. phys. Chem.* 39. *Abt.B.* 5-6. *p.* 476, 1938.—A correction. [See Abstract 4600 (1937).]

2941. Calculation of Calorific Powers of Hydrocarbons. M. Brutzcus. *Comptes Rendus,* 206. *pp.* 1291–1294, *May* 2, 1938.—From the results previously obtained formulæ for the calorific powers (P) of various series of hydrocarbons (including cyclic) are deduced, *e.g.*, for the paraffins C_mH_{2m+2}, $P = 156\cdot 9m + 58\cdot 3$ kg.cal., for C_mH_{2m}, $P = 156\cdot 9m + 22\cdot 6$ kg.cal. Results are exemplified by comparison with experimental results. C. A. S.

2942. Heats of Combustion of Hippuric and Succinic Acids. H. M. Huffman. *Am. Chem. Soc., J.* 60. *pp.* 1171–1177, *May,* 1938.—Experimental data are reported for the heats of combustion of hippuric acid and succinic acid, and from these are calculated values for the heats of formation. These data are compared with existing values. Hippuric acid is shown to be a substance whose properties fulfil the requirements for a bomb calorimetric standard, and it is proposed that hippuric acids (crystallised from water) be used as a secondary standard, for investigations on nitrogen-containing compounds. The value proposed for the heat of combustion of hippuric acid crystallised from water is 23,546·3 N.B.S. international joules, or 5628·6 cal./gm., under the standard conditions for the bomb process at 25°. The " precision and accuracy " uncertainties are, respectively, ± 0·009 and ± 0·025%. AUTHOR.

2943. Heat of Formation and Specific Heat of Tantalum Nitride. S. Satoh. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 782. *pp.* 477–486, *May,* 1938. *In English.*—The mean specific heat of TaN was measured by the ice calorimeter over three temperature intervals: 0° C.~ 99·5° C., 0° C.~ 305·3° C., 0° C.~ 500·3° C., and the equation of the true specific heat was obtained: $C = 0\cdot 04785 + 7\cdot 068 \times 10^{-5}t - 5\cdot 808 \times 10^{-8}t^2$. By using these values, the heat of formation at 25° C. was computed from the dissociation pressure at high temperatures. The result obtained is as follows: $Ta + N = TaN + 58650$. The relationship between the heats of formation of nitrides of the elements belonging to the fifth series, fifth and sixth groups of the periodic table of the elements and their atomic numbers is discussed. [See also Abstracts 1678 and 1679 (1938).] AUTHOR.

2944. Calcium Subfluoride. K. H. Hellwege. *Zeits. f. phys. Chem.* 39. *Abt.B.* 5–6. *pp.* 465–470, 1938.—Predissociation observed in the band spectrum of CaF vapour leads to the conclusion that the dissociation of the CaF molecule gives rise to an excited Ca atom. Heats of reaction are calculated for $CaF + F = CaF_2$ and for $CaF_2 + Ca = 2CaF$. The existence of solid CaF is investigated and the order of magnitude of its heat of sublimation is estimated. C. B. A.

2945. Influence of Moisture on the Intensity of the Visible Radiation of the Flame of CO and O_2. H. Kondratjewa and V. Kondratjew. *Acta Physicochimica,* 8. 4. *pp.* 481–490, 1938. *In English.*—The light yield in the visible part of the spectrum of the flame of $2CO + O_2$ has been measured as a function of the amount of water vapour contained in the reaction mixture. It has been shown that the light yield decreases rapidly with increase of the partial pressure of water vapour. It is suggested that the observed effect is due to a continuous change in the oxidation mechanism. It is suggested that water plays a twofold rôle: as the initiator of the reaction chain and as a participator in the latter (as OH radicals and H atoms). From a comparison of the rates of oxidation of CO and conversion of the water gas an estimate is obtained for the average length of a chain. [See also Abstracts 3179 and 3662 (1937).]

2946. Flame Propagation in the System Dinitrogen Pentoxide-Ozone. T. M. Lowry and R. V. Seddon. *Chem. Soc., J. pp.* 626–631, *May*, 1938.—By spectrographic means it has been proved that the unstable dinitrogen hexoxide is present in a mixture of the pentoxide (nitric anhydride) and ozone undergoing slow decomposition and also in the flame-front in the explosive reaction of these gases. The kinetics of the slow reaction have been studied, and the mechanism shown to involve successively the unimolecular decomposition of the pentoxide, the reaction of ozone with the products, a bimolecular reaction of nitrogen trioxide formed in both the previous steps, and then the re-formation of dinitrogen pentoxide. The mechanism of the explosive reaction is exactly the same, the sequence of reactions proceeding at such a rate as to be adiabatic and self-propagating. AUTHORS.

2947. Effect of Solid Admixtures on Velocity of Propagation of Flame in Combustible Gas Mixtures. S. Gribkova and A. Predwoditelev. *Techn. Phys., U.S.S.R.* 5. 2. *pp.* 153–166, 1938. *In English.*—The combustible gas studied is a dried mixture of CO and air, a photographic method being used to determine the velocity of flame propagation in a tube some 2 m. long. The effect of admixing dusts of known particle size and concentration is determined. When silica gel, an inert dust which absorbs energy, is used the velocity of propagation of the flame decreases as the concentration of the dust increases, the rate of decrease increasing with the fineness of the dust. The results obey the empirical formula, $u = u_0 - cG/r$, (u_0 = velocity in absence of dust; r = average size of dust particles; G = dust concentration and c = constant). Using activated charcoal dust, which burns and thus gives up energy, the reverse result is obtained, the rate of propagation being increased. The results are interpreted on the basis of a consideration of the thermal conductivity mechanism of flame propagation. The displacement velocity of the flame is also derived in terms of the temperature distribution in the flame front. The theoretical expressions confirm those obtained empirically. R. W. P.

See also Abstracts 2691, 2926.

THERMODYNAMICS.

2948. Collective Electron Energy and Specific Heat. E. C. Stoner. *Phil. Mag.* 25. *pp.* 899–925, *June*, 1938. *Supplement.*—The specific heat of a gas of particles which obey Fermi-Dirac statistics, and whose energy is proportional to the square of their momentum, is accurately computed. The results are given in units which are convenient for the application to the electronic specific heat of metals. R. P.

2949. Transformations of Solid CD_4 and of its Mixture with CH_4. E. Bartholomé, G. Drikos and A. Eucken. *Zeits. f. phys. Chem.* 39. *Abt.B.* 5–6. *pp.* 371–384, 1938.—In contrast to CH_4, the molar heat of condensed CD_4 shows two peaks in the C_pT curve at 21·9° and 26·95°. In a series of mixtures of CH_4–CD_4 the peaks remain as sharp. The higher peak of CD_4 lies over the peak of CH_4 so that the transformation temperature is linear with the proportion of CD_4. In a similar way the lower transformation temperature of CD_4 lags behind with increasing CD_4 content, and disappears when the proportion of CH_4 reaches 85%. The method of purifying the CD_4 is described and illustrated, and the calorimeter used has been described elsewhere [see Abstract 534 (1935)]. The discussion of the results leads among other things to the conclusion that the transformation process is determined more by the statistical behaviour of a group of molecules, *i.e.*, over an area, than by a single molecule. E. H. D.

2950. Free Energy and Entropy of Nitrosyl Chloride. F. P. Jahn. *J. Chem. Phys.* 6. *pp.* 335–338, *June*, 1938.—Using the harmonic oscillator rigid rotator approximation to the partition function of nitrosyl chloride, the values of the free energy function, $(F^0-E_0^0)/T$, and the entropy, S^0, have been calculated for the ideal gas from 298·1°K. to 1000°K. at fifty degree intervals. By comparison with the equilibrium data for the dissociation of nitrosyl chloride, ΔE_0^0 is found to be 15,510 ± 53 cal. It is found necessary to assume an electronic weight of four for the ground state. Although the calculated equilibrium constants agree fairly well with experiment, a definite trend in the deviations cannot be satisfactorily explained. AUTHOR.

See also Abstracts 2644, 2691, 2719, 2728, 2729, 2932, 2981, 2982.

VAPORISATION AND CONDENSATION.

2951. Nature of Ionic Sign Preference in Wilson Cloud Chamber Condensation Experiments. L. B. Loeb, A. F. Kip and A. W. Einarsson. *J. Chem. Phys.* 6. *pp.* 264–273, *May*, 1938.—Experiments made to ascertain if the charge preference in the Wilson cloud method of condensation was due to different hygroscopic impurities brought into the embryonic droplets by ions of different sign proved definitely negative. Since the electrical double layers at liquid-gas surfaces are also incapable of explaining the phenomenon the following hypothesis was evolved and compared with existing data and with new results on various organic liquids. It is assumed that the saturated vapour contains embryonic droplets of radius insufficient to bring surface tension forces into play. These droplets, unlike the larger and more stable visible and invisible droplets, are in a state neither crystalline nor liquid but in a pseudo-crystalline state having definite space structure. In such droplets the orientation of the molecules is determined by van der Waals forces which are directive. If the droplet and vapour consist of polar molecules whose dipole moment is oriented in such a direction as to bring approaching vapour molecules to the pseudo-crystal surface in an orientation favourable to further structural growth, the sign of charge favouring this process will produce visible droplets at a lower supersaturation than will the opposite sign. Once condensation has proceeded to a point where surface tension forces are fully developed the droplet goes over to the liquid state having an electrical double layer and neither sign of charge has any further influence on condensation. A. W.

2952. Measurements of Low Vapour Pressures of Alkali Halides. J. E. Mayer and I. H. Wintner. *J. Chem. Phys.* 6. *pp.* 301–306, *June*, 1938.—The vapour pressures over the crystalline salts are measured in the neighbourhood of 900°K. by Knudsen's method for the chlorides and bromides of Na, K and Rb. Heats of vaporisation are calculated from the data. AUTHORS.

2953. Dipole Interaction in Mixtures of Water with Methyl, Ethyl, and *n*-Propyl Alcohols, and of Ethyl Alcohol with *n*-Heptane. A. R. Martin and A. C. Brown. *Faraday Soc., Trans.* 34. *pp.* 742–748, *June*, 1938.—Dipole interaction accounts for the deviations from Raoult's law of the partial vapour pressures of water in mixtures with methyl, ethyl, and *n*-propyl alcohols except in the neighbourhood of pure water, where the influence of the pseudo-crystalline structure of water is apparent. The behaviour of ethyl alcohol in mixtures with *n*-heptane resembles that of benzyl alcohol and phenol in mixtures with benzene, particularly in that even that of the pure hydroxylic substance can be accounted for by dipole interaction. AUTHORS.

ACOUSTICS.

2954. Tone-Quality of Organ Pipes. M. Mokhtar. *Univ. Durham Phil. Soc., Proc.* 9. *pp.* 352–355, *March*, 1938.—Microphone, amplifier and kathode-ray oscillograph are used to study the influence of blowing pressure upon the tone quality of a flue pipe and to illustrate the theory of the tone production in such pipes. Oscillograms taken with blowing pressures varying from 0·26 cm. to 16 cm. of water show complex changes. W. H. G.

2955. Acoustical Conductivity of Orifices. N. W. Robinson. *Phys. Soc., Proc.* 50. *pp.* 599–615, *July* 1, 1938.—Measurements made on the acoustical conductivities of the following orifices are described : (1) At the junctions between two tubes in series and two tubes in parallel ; (2) Multiple thin orifices in parallel ; (3) Long orifices forming constrictions in a tube and long orifices terminating a tube. Equations are given for calculating the conductivities of orifices associated with various acoustical structures. A method is described of determining the shapes of acoustical wave-fronts near any constriction in a cylindrical tube, and results are given for thin circular orifices. AUTHOR.

2956. Velocity of Sound in Air. R. C. Colwell, A. W. Friend and D. A. McGraw. *Frank. Inst., J.* 225. *pp.* 579–583, *May*, 1938.—A laboratory method. A valve and loud-speaker are worked off mains at 110 V and 60 ~, so that 60 short impulses are given to the loud-speaker per sec. The sound impulses are picked up by a microphone, converted, amplified and then observed in a kathode-ray oscilloscope. The position of the microphone near the loud-speaker is adjusted so that the peak pulse falls on a vertical line at the centre of the screen, and the position is marked. The microphone is now moved away about 18 ft. and again adjusted. The displacement of the microphone is the distance gone by the sound in 1/60 sec. Measurements were made as a test of the method, and the average of 100 measurements, reduced to 0° C. was 331·54 m./sec. The walls of the room require to be covered with absorbing material to avoid echo effects. G. E. A.

2957. Recent Progress in Supersonics. W. T. Richards. *J. of Applied Physics*, 9. *pp.* 298–306, *May*, 1938.—The development of supersonics during the last five years is reviewed in both its theoretical and experimental aspects, and suggestions for future investigations are made. The review includes discussions of the propagation of supersonic sound in gases, liquids and solids, the dispersion and absorption in polyatomic gases, the effects of intense sonic and supersonic radiation. K. M. C.

2958. Transparency of Solid Plates to Supersonic Waves. E. Baumgardt. *Comptes Rendus,* 206. *pp.* 1284–1286, *May* 2, 1938.—To test if the elastic constants of iron vary under the influence of supersonic frequencies of 4000 kc. and greater, discs of 40 mm. dia. and varying thickness are put into a stream of supersonic waves and the acoustical energy which penetrates is measured by a torsion balance. The position of transparency is sharp enough to measure the velocity of propagation of the waves to 1% in soft steel. This gives a result for the elasticity near enough to that measured statically to show that frequency does not enter into the results. Experiments are now being made using the diffraction of light by supersonics, thus eliminating sources of error by reducing the energy used.

H. M. B.

2959. Propagation of Supersonics in Capillary Tubes. J. May. *Phys. Soc., Proc.* 50. *pp.* 553–559; *Disc.,* 559–560, *July* 1, 1938.—The velocity and attenuation constants for the propagation of supersonic vibrations, of frequencies 40 to 115 kc./sec., in air contained in narrow tubes, of dia. 0·06 to 0·15 cm., are measured, the sources being monel needles in magnetostrictive oscillation. On comparison with Kirchhoff's theory, the results show that the absorption in the tubes is considerably greater in practice than in theory, though not markedly different from that observed at low frequencies. AUTHOR.

2960. Determination of Elasto-Optical Constants with Supersonic Waves. H. Mueller. *Zeits. f. Krist.* 99. 2. *pp.* 122–141, 1938. *In English.*—The intensities and the polarisation of the light diffracted by supersonic waves in cubic crystals and glasses are calculated on the basis of the Raman-Nath theory by taking into account the photoelastic effects of the sound waves. It is shown how the ratios between the elasto-optical constants can be determined from investigations of the polarisation or the intensities of the diffracted light. AUTHOR.

2961. Grating Theory. J. F. C. Patry. *Helv. Phys. Acta,* 11. 3. *pp.* 189–206, 1938. *In French.*—The method of Extermann as applied to the diffraction of light by supersonic waves is employed. The grating is considered plane with a periodic variation in optical properties. The amplitude of this together with the relation between the wave-length and grating spacing control the phenomena. Since the ratio of the two factors is about the same in the two cases Extermann's tables may be directly applied.

H. G. C.

2962. Precision Method of High Absolute Accuracy for Determining the Velocity of Supersonic Waves in Liquids. N. Seifen. *Zeits. f. Physik,* 108. 11–12. *pp.* 681–697, 1938.—The method developed by Hiedemann and his collaborators for determining the velocity of supersonic waves in liquids was modified so as to render it a precision method of high absolute accuracy. The essential improvement consisted in the use of constant frequencies standardised by means of a luminous quartz resonator whose frequency is known to better than 5 parts in 10^6. A two-stage oscillator of the electron coupled type was used as h.f. generator and when operated in an air thermostat gave a sufficiently high frequency constancy. With these improvements measurements of the velocity of supersonic waves could be made to an accuracy of 5 parts in 10^5 and over a wide frequency range to 6 or 7 parts in 10^5. Measurements were made of the velocities in water, toluol, aniline, xylol, nitrobenzol and CCl_3 in the temperature range 23° to 27° C., from which temperature coefficients were determined with an accuracy of 2 to 3%. A. W.

2963. Expression of the Opening and Closing of the Glottis in the Period of the Sound in Air. W. Trendelenburg and W. Hartmann. *Preuss. Akad. Wiss. Berlin, Ber.* 28. *pp.* 391–398, 1937.—Experiments with larynx preparations show that in curves of filtered sounds produced by these larynges the one group of h.f. vibrations appears both at the opening and at the closing of the glottis. This verifies the assumption of F. and W. Trendelenburg that the two groups of vibrations observed by them in vowel sounds, one of which begins simultaneously with the " commencing group " of the total vowel curve, are due to the changing conditions at the moments of opening and closing the glottis. G. E. A.

2964. Influence of a Resonator upon the Sound Field. K. Satô. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 312–318, *April*, 1938. *In English.*—A study is made of the effect of a Helmholtz resonator on the sound field of an organ pipe blown with constant pressure. The resonator frequency was variable and the experiments were carried out in a soundproof room. The results obtained are presented in a series of curves for different relative positions of resonator axis and sound source and for different resonator frequencies. The results show that while in the nonresonant state a resonator exerts no influence upon the sound field, there is a marked disturbance of the field in the case of resonance due to the absorption of energy from the sound field by the resonator. In this case also the resonator acts as a secondary source, which gives rise to further disturbance of the sound field. A. W.

2965. Reflection of Sound. K. F. Herzfeld. *Phys. Rev.* 53. *pp.* 899–906, *June* 1, 1938.—The losses in the reflection of sound on solids are investigated. The heat conduction of the solid disturbs the temperature distribution in the gas and sets up a temperature wave. The fact that the pressure in the gas near the wall is no longer in phase with the density results in a heating of the gas on the wall. The effect amounts to a few percent for a million cycles. The scattering of the molecules on the wall, the scattering of the sound waves by uneven places and the effect of adsorption are also investigated. They become important only at higher frequencies. AUTHOR.

See also Abstracts 2692, 2730 and

2357B. Noise Insulation. G. W. C. Kaye.

2358B. Reduction of Noise from Air Compressor. J. E. R. Constable.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

2966. Applications of Lagrangian Equations to Electrical Circuits. D. A. Wells. *J. of Applied Physics,* 9. *pp.* 312–320, *May,* 1938.—An introductory review of the application of Lagrange's equations to mechanical systems is followed by a development of a form conveniently applicable to electrical circuits. Examples are given showing that while the Lagrangian method of arriving at the differential equations of a simple stationary electrical circuit offers no particular advantage over the application of Kirchhoff's law, it greatly simplifies the treatment of combined electrical-mechanical systems, particularly where it may be convenient

to use other than rectangular coordinates for the moving parts. The Lagrangian method has a wide field of usefulness in modern practice.
R. E. N.

See also Abstract 3027 and
2151B. Resonance Theory of Series Non-Linear Control Circuits. E. G. Keller.

CONDUCTION AND DISCHARGE IN GASES.

2967. Simple Relation in the Glow Discharge. Y. Kasiwagi. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 781. *pp.* 461–476, *May,* 1938. *In English.*—The author has studied systematically the discharge in N_2 using various combinations of metals for the kathode and anode and has found : (1) The difference of the terminal voltage and the p.d. due to the positive column can be expressed as the square of the vertex distance by the following equation : $V - nu - V_0 = Bk^2$, where V is the terminal voltage, nu the p.d. due to positive column, k the vertex distance, and V_0, B are two constants to be determined. (2) The constant V_0 is independent of the pressure and the sizes of the tube, but depends upon the materials of the electrodes. (3) V_0 comes out as the sum of two functions, the one depending upon the kathode only the other the anode only with an additive constant. The former was interpreted as the normal kathode fall, and the latter the normal anode fall. AUTHOR.

2968. Effect of Positive Ion Bombardment on the Emission of Electrons from the Kathode in the Glow Discharge. Part II. A. Güntherschulze and H. Betz. *Zeits. f. Physik,* 108. 11–12. *pp.* 780–785, 1938.—Continuing previous work [see Abstract 817 (1938)] the effect of positive ion bombardment on the electron emission from oxide layers situated on kathodes of K, Mg, Al, Cu, Fe, Ag and Pt is examined. The electron emission is much increased, that for Mg at 2000 V being 5 times the normal emission. The results allow the formation of oxide or hydride layers to be followed with great precision. [See following Abstract.] F. C. C.

2969. Effect of Positive Ion Bombardment on the Electron Current from the Kathode in the Glow Discharge. Part III. A. Güntherschulze and W. Bär. *Zeits. f. Physik,* 109. 1–2. *pp.* 121–126, 1938.—Denoting the electron yield per ion by γ, the γ-kathode potential fall curves are obtained under various conditions. The value of γ is less for pure surfaces than for the oxides and for He, H_2 and Ne the curves are of higher curvature if oxide sheets are used. The curves were extended up to 3000 volts for A, Kr, Xe, O_2 and N_2. The results can be explained if the effect of the ions on both the underlying kathode and the surface oxide layer are considered. [See preceding Abstract.] F. C. C.

2970. Potential Gradient in Positive Column. S. Gvosdover. *Phys. Zeits. d. Sowjetunion,* 13. 2. *pp.* 133–140, 1938. *In English.*—A formula for the longitudinal gradient of the positive column is derived taking into account the influence of the walls of the discharge tube. [See Abstract 5420 (1937).] AUTHOR.

2971. Experimental Study of Electron Affinity. L. Goldstein. *Ann. de Physique,* 9. *pp.* 723–803, *May–June,* 1938.—The process of electron capture in O_2, SF_6, CF_4 and in mixtures of these gases with A, Xe and Kr has been studied by a modified Franck-Hertz method. Special attention was paid to the purity of the gas, and it is shown that atoms formed by dissociation of the molecule studied are responsible for the observed affinity. When atoms are absent no negative ions are formed. The optimum voltages for electron capture in mixtures containing $O_2 + O + O_3$, $SF_6 + F$ and $CF_4 + F$ are 0·14, 0·6 and 0·7 respectively. The upper limits for capture in $O_2 + O$ and $O_2 + O + O_3$ are 1·4 and 2·8 eV, and 3·5 eV in $SF_6 + F$ and $CF_4 + F$. In addition the following ionisation potentials have been found : O_2 — 12·6, 16·2 and 21·3 eV, SF_6 — 19·3 eV and CF_4 — 17·8 eV. The author considers that contradictory results found by previous investigators may be ascribed to impurities either in the initial gas or invoked by the electron collisions themselves (atom formation). G. C. E.

2972. Experimental Contribution to the Question of the Validity of the Spin Conservation Law. K. Galler. *Phys. Zeits.* 39. *pp.* 407–409, *May* 15, 1938.—It is sought to prove the spin conservation law experimentally for the case of the excitation of atoms by collisions in which the kinetic energies of the colliding particles greatly exceed their excitation energies. Collisions between He atoms and Be, Mg, Ca and Sr atoms are investigated and in all cases triplet excitation of the alkaline earth metals is observed without simultaneous excitation of He atoms. This observation appears at first to disprove the spin conservation law for the case of excitation by atomic collisions, but if on the other hand it be assumed that metastable He atoms are present in the He canal ray before the collisions with the alkaline earth metals take place, the experimental result speaks more in favour of validity of the law than against it.

J. E. K.

2973. Discharge Phenomena and Ion Formation in Canal Rays. C. Hailer. *Wiss. Veröff. a. d. Siemens-Werken*, 17. 3. *pp.* 115–134, 1938. —In canal-ray discharge tubes, electrons are produced by impacts between positive ions and electrons ; the effect of secondary electrons on the positive ion beam is negligible. By using a diaphragm in the discharge tube, the ion beam can be concentrated to a high degree which results in the formation of more ions, provided the canal is suitably reduced in order to cut down the gas pressure in the beam. A canal ray tube is described which is particularly suitable as an ion source for atomic transformation experiments and which, with an exciting potential of 30 kV and a discharge current of 20 mA, yields an ion current of more than 1 mA. A mass spectrograph photograph shows that, in this tube, about 30% of the total ions are protons and that the majority of the ions are produced in the region of the diaphragm. [See also Abstract 980 (1937) and following Abstract.] H. J. H. S.

2974. Mass-Spectrograph Examination of H_2 and He Canal Rays. W. Schütze. *Wiss. Veröff. a. d. Siemens-Werken*, 17. 3. *pp.* 135–156, 1938.—A mass spectrometer is described which operates on the parabola principle and which utilises the all-metal canal-ray tube described by Hailer [see preceding Abstract]. The canal rays, after passing through several diaphragms and between the poles of an electromagnet (which are simultaneously the plates of a condenser), fall either on a photographic plate or on a Faraday cage. The instrument is used for studying the intensity distribution of ions of H_2 and He canal rays. It is found that the primary ions H_2^+ and He^+ have fallen through 70–75% of the discharge tube potential and that, in the case of H_2, the well known types of ion which appear are due to decomposition or synthesis of the primary ions. The existence of He_2^+ as well as H_4^+ ions postulated by R. Döpel is proved experimentally and it is shown that processes occur such as $H_4^+ \rightarrow H_2^+$,

$H_4^+ \rightarrow H_3^+$, $H_4 \rightarrow H_1^+$, $H_4^+ \rightarrow H_1^-$. The ions H_4^+ and He_2^+ are so unstable that they cannot be directly observed as parabolæ. H. J. H. S.

***2975. Transport of Ions by Current of Vapour to Obtain High Voltage. J. Virgitti.** *Comptes Rendus*, 206. *pp.* 1367–1369, *May* 9, 1938.—The conditions for obtaining an electric current by passing a current of suitable gas or vapour (of CCl_4 is most suitable) through an ionised field, then along a tube of insulating material and collecting the ions, are examined. This method is found to require a quite disproportionate amount of power, *e.g.*, 900 kV to obtain 130μ A. [See Abstract 865 (1936).] C. A. S.

See also Abstracts 2656, 2836, 2837, 2838, 2839, 2852, 2920, 2951, 2977 and 2114B. Energy Transfer in Positive Column of the Rare Gases. G. Mierdel.

CONDUCTION IN SOLIDS AND LIQUIDS.

***2976. Corrections for Winding Space of Coils of Rayleigh Current Balance. H. v. Steinwehr and W. Gremmer.** *Phys. Zeits.* 39. *pp.* 399–401, *May* 15, 1938. *From the Reichsanstalt.*—The formula of O. Snow [see Abstract 2995 (1934)] is put into a form giving the correction directly in terms of the apparent, electromagnetically determined, ratio of the radii of the coils, and of the width and depth of their winding spaces. P. V.

***2977. Stabiliser with only Two Valves for Each Stage. K. E. Forsman.** *Phys. Zeits.* 39. *pp.* 410–412, *May* 15, 1938.—Details are given for the construction of a stabiliser using only two valves for each stage. The apparatus is similar to but more economical than the four valve stabiliser of Stevenson and Getting [see Abstract 299 (1938).] F. C. C.

***2978. Resistance Material "Isabellin." A. Schulze.** *Phys. Zeits.* 39. *pp.* 401–407, *May* 15, 1938. *From the Reichsanstalt.*—A Mn-Cu alloy containing Al, and called "Isabellin" was investigated for use in electrical resistance standards. The thermal coefficient of resistance at room-temperatures can be reduced to only a few parts in a million per degree C. by heat treatment at 500° C. The thermo-e.m.f. of Cu-isabellin junctions is extremely small, the mechanical properties are suitable, and the secular change of resistance appears to be small. Isabellin therefore appears very suitable for resistance standards. P. V.

2979. Specific Resistance and Temperature Variation of Resistance of Tin Crystals. B. Chalmers and R. H. Humphry. *Phil. Mag.* 25. *pp.* 1108–1113, *June*, 1938.—Measurements are described and results given of the specific resistance and temperature coefficient of resistance for single crystals of tin in directions parallel and perpendicular to the *c*-axis. The tin was of two degrees of purity, 99·987 and 99·996%. The influence of this difference of purity is discussed. AUTHORS.

2980. Equilibrium of Supraconductors. N. Felici. *J. de Physique et le Radium*, 9. *pp.* 149–156, *April*, 1938.—Various authors have introduced the idea that a supraconductor is characterised by the absence of a magnetic field within the metal. Attention is directed towards the analogous fundamental characteristic of conductors in electrical equilibrium, namely, the absence of an electrical field within the metal. One can deduce all the properties of supraconducting systems when in equilibrium from this one hypothesis that $H = 0$, and in each case correlation can be made with results derived for electrical conductors in equilibrium from the assumption $E = 0$. On this basis theoretical explanations are formulated for known experimental facts, and other phenomena are predicted which have not yet been studied experimentally. R. W. P.

2981. Thermodynamics of Supraconduction. M. v. Laue. *Ann. d. Physik*, 32. 1–2. *pp.* 71–84, *May*, 1938.—The thermodynamic equation $T\delta S - \delta U + A \leqq O$, where T is the temperature, S the entropy, U the energy, and A the work associated with the change of state of the system is applied to the problem of supraconductivity. The treatment is simplified by asuming that the magnetic properties involved are independent of temperature. By the introduction of London's electrodynamics of supraconductivity, and by also making the assumption that the characteristic constant is independent of temperature, it is found possible to obtain a theoretical curve for the dependence of the threshold value of the magnetic field on the radius of a thin conducting wire. Experimental results obtained by Pontius [see Abstract 5431 (1937)] for lead wires at 4·2° K. in a longitudinal field are shown to be in good agreement with this curve. [See following Abstract.] R. W. P.

2982. Magnetic Threshold Values for Supraconductivity. M. v. Laue. *Ann. d. Physik*, 32. 3. *pp.* 253–258, *June*, 1938.—The results of an earlier investigation [see preceding Abstract], which were obtained from consideration of the thermodynamic equilibrium between the supraconducting and normal conducting phases of a substance, are applied to cases in which the conductor has various forms. General equations for the threshold values of the magnetic field are now given for a sphere in a homogeneous magnetic field, whilst in the earlier paper solutions were given for cylindrical conductors in both longitudinal and transverse fields, for current carrying cylinders and also for a cylindrical cavity in a thick medium. R. W. P.

2983. Electric Currents and Counter E.M.F.'s in Paraffin Wax in the Natural State and Subjected to γ-Radiation. W. Ścisłowski. *Acta Physica Polonica*, 6. 4. *pp.* 403–424, 1937. *In German.*—The author's electrometer method was employed to investigate the initial currents (for times from 0·05 to 2 sec.), the counter e.m.f.'s and the currents for longer times (from 1 to 20 min.) in specially prepared paraffin wax samples at room-temperature and constant voltage. Results were obtained both for paraffin in the natural state and when subjected to γ-radiation. From the characteristics obtained it is concluded that the electric current observed in paraffin wax is the sum of a residual current and a conduction current of fundamentally different properties. A. W.

See also Abstracts 2669, 2672, 2742, 2792, 3020, 3040.

DIELECTRICS AND CAPACITANCE.

2984. Dielectric Constants of Ionised Gases. Part II. S. Gangopadhyaya and S. R. Khastgir. *Phil. Mag.* 25. *pp.* 883–895, *June*, 1938. *Supplement.*—Measurements of the dielectric constants of ionised air and nitrogen have been made for ultra-high frequencies using condenser plates placed *outside* the discharge tube [see also Abstract 2779 (1937)]. The value of the dielectric constant (which is less than unity) is found to decrease with increase of tube-current only up to a certain value of the latter, and beyond it gradually attains the value of unity and subsequently becomes greater than one for larger tube-currents. The experimental results are explained as due to the formation of ionic sheaths round the inside surface of the discharge-tube. When the ionic sheath was almost eliminated by using an earthed cylindrical copper anode (with slits) surrounding the inside of an air-discharge tube and an aluminium kathode in the shape of a straight rod along the axis of the copper cylinder, the dielectric constant of ionised air was always less than one. Dielectric constant—ionisation curves exhibit irregularities which are explained as due tò the effect of conductivity acquired by the ionised medium. When the wave-length was charged keeping the tube-current constant, the dielectric constant of the ionised air decreased nearly proportionately with the square of the wave-length up to a particular value of the latter, thereby showing agreement with the Eccles-Larmor formula up to that point. Beyond this wave-length the dielectric constant increased, the turning point not being due to the effect of plasma electronic resonance. The supplement deals with the dispersion formula.

H. H. Ho.

2985. Dielectric Constant of D_2O. J. Wyman, Jr., and E. N. Ingalls. *Am. Chem. Soc., J.* 60. *pp.* 1182–1184, *May,* 1938.—Values of the dielectric constant and its temperature coefficient are reported for D_2O and H_2O between 0 and 100°. The dielectric constant of D_2O is slightly less than that of H_2O over the whole range; its temperature coefficient is everywhere very nearly the same. The bearing of the results on the problem of heats of solvation and heats of dilution of strong electrolytes is discussed. AUTHORS.

2986. Permanent Electric Moments of Alkali Metal Halides. P. Trautteur. *N. Cimento,* 15. *pp.* 5–9, *Jan.,* 1938.—The Debye formula is applied to the calculation of the electric moment of CsI, RbBr, and KCl, in which the constituent ions have similar structures to those of the rare gases. The differences between the experimental and calculated values may be attributed to deformation of the outer electronic levels by the constituents of the molecule. It is found empirically that the variation of the electric moment depends in a regular manner on the number of electrons in the molecule. C. J. B. C.

2987. Possibility of Molecular Rotation in the Solid Forms of Cetyl Alcohol and Three Long-Chain Ethyl Esters. W. O. Baker and C. P. Smyth. *Am. Chem. Soc., J.* 60. *pp.* 1229–1236, *May,* 1938.—The dielectric constants of ethyl undecylate, palmitate and stearate and cetyl alcohol have been measured over a wide range of temperature and frequency in the liquid and solid states in order to investigate the possibility of molecular rotation in the solid forms. Ethyl undecylate shows no general freedom of molecular rotation in the solid, the melting temperature evidently being too low to permit the molecules to acquire sufficient rotational energy to overcome the intermolecular forces. Ethyl palmitate undergoes a solid α–β transition at its freezing point and, during the process, shows greater freedom of molecular rotation than in the liquid. It also shows a slight transition in the β-form not hitherto detected. Ethyl stearate shows molecular rotation around the long axis in the α-form. Cetyl alcohol shows molecular rotation in the α-form accompanied by strong anomalous dispersion of the dielectric constant. In the α-forms where the long molecules lie perpendicular to the planes in which their heads lie, rotation around the long axes of the molecules appears to be possible, but, in the β-forms where the molecules are tilted with respect to the planes and more closely packed, no general freedom of rotation is found. AUTHORS.

See also Abstracts 2741, 2742, 2792, 2859, 2953 and

2125B. Temperature Variation of H.F. Condensers. L. Rohde.

V.
19

ELECTROCHEMISTRY.

2988. Electrolytic Thermo-Cells. J. J. Hermans. *Zeits. f. phys. Chem.* 182. *Abt.A.* 1. *pp.* 49–53, 1938.—The electrolytic thermo-cell is discussed briefly from a theoretical standpoint. Szabó's conclusions [see Abstract 838 (1938)] are criticised on the following grounds. 1. Sufficient regard is not paid to the activity coefficient. 2. The relation with Peltier heat and heats of transport is improperly deduced. 3. Even Szabó's very accurate measurements are not sufficient to lead to definite conclusions regarding ionic activities. In reply (*ibid. p.* 54.) **Z. Szabó** points out that his work was an attempt to obtain an expression for ionic coefficients, hitherto unobtainable, by approximation; in concentrated solutions the approximate nature of the relation is still more marked. Further, it is not the *value* of the heat of dilution but its dependence on concentration, which is important. Only determinations of ionic activity coefficients by other methods will be of real evidence in checking the author's original method of approximation. D. R. H.

2989. Electrolytic Water-Transport and Ionic Hydration Numbers. H. C. Hepburn. *Phil. Mag.* 25. *pp.* 1074–1096, *June*, 1938.—A review of the various methods that have been employed to determine the hydration of electrolytic ions in aqueous solution indicates that the most consistent results have been obtained from those methods which are based upon the measurement of the amount of water transported with the ions during electrolysis. The author concludes that the most convenient of the latter methods is that involving the use of a parchment-paper diaphragm and consisting in the measurement of the volume changes produced during electrolysis. He has devised a sensitive form of apparatus for the purpose of such measurements and has developed an accurate expression for the electrolytic water-transport in terms of the observed volume change, the Hittorf transport number of the anion, and the partial molal volumes of the solute and of the solvent. A series of measurements has been carried out with solutions of NaCl in order to investigate a serious discrepancy shown by the earlier results relating to this salt. At the same time, the results of the author relating to solutions of $CuSO_4$ and of $CuCl_2$ computed in former papers by means of an approximate expression, have been recalculated. The results so obtained for these solutions, together with those obtained for the NaCl solutions, have been employed to determine the true transport numbers and the hydration numbers of the respective ions; and the ionic complexity of $CuCl_2$ solution is examined in the light of these results. AUTHOR.

2990. Mobility of Ions in Very Viscous Liquid Dielectrics. J. Świętosławska-Ścisłowska and I. Adamczewski. *Acta Physica Polonica*, 6. 4. *pp.* 425–431, 1937. *In French.*—A simple and direct method for the measurement of the mobility of ions in very viscous liquids, *e.g.*, paraffin oil, is developed. The method consists in passing a beam of X-rays through the carefully purified oil, which was contained in a condenser and measuring the current with a quadrant electrometer. The paraffin oil used had a viscosity coefficient of 1·73. The values found for the mobility of the ions were of the order of 10^{-6}cm./sec. cm./volt. F. J. B.

2991. Mobility of Ions and Temperature in Liquid Dielectrics. J. Adamczewski. *Acta Physica Polonica*, 6. 4. *pp.* 432–444, 1937. *In French.* The mobility of ions (u) was measured in paraffin oil and the coefficient of the viscosity (η) was determined over a temperature range.

The mobility of the ions was determined as a function of the temperature. Taking the relationship $u = f(\eta)$ as a basis, the law of Stokes can be considered as valid in the present instance. F. J. B.

2992. Electrochemistry of the Rusting Process along a Scratch-Line on Iron. R. S. Thornhill and U. R. Evans. *Chem. Soc., J. pp.* 614–621, *May*, 1938.—An apparatus is described which permits the measurement of electric currents passing around a scratch-line on iron covered with filter-paper soaked in bicarbonate solution; a fraction of the current is diverted through two nearly non-polarising electrodes to a galvanometer, and calibration on a second paper through which known currents are passed gives the relation between the galvanometer readings and the true current flowing through the first paper. The relation between the current and the corrosion produced suggests that the corrosion is mainly or wholly electrochemical. Ferrous ions are formed in the early stages, in amount corresponding approximately to the current passing; later, electrochemical oxidation of ferrous to ferric iron appears to set in, increasing the current in relation to the corrosion velocity. AUTHORS.

2993. Meaning and Standardisation of the pH Scale. D. A. MacInnes, D. Belcher and T. Shedlovsky. *Am. Chem. Soc., J.* 60. *pp.* 1094–1099, *May*, 1938.—Measurement of the potentials, E, of cells of the type (Pt), H_2; buffer solution : KCl (satd.) : KCl (0·1 *N*), HgCl; Hg were made at 12, 15 and 38°. The results were interpreted with the purpose of obtaining values of E_0 in the equation $\text{pH} = (E - E_0)/(2{\cdot}3026RT/F)$ which will yield values of pH which are as useful as appears to be possible in the determination of ionisation and other equilibrium constants. The pH values of commonly used acetate and phthalate buffers have been redetermined at the temperatures given and expressed on the basis just described. AUTHORS.

2994. Reproducibility of Ag-AgCl Electrode. E. R. Smith and J. K. Taylor. *Bureau of Standards, J. of Research*, 20. *pp.* 837–847, *June*, 1938.—A study was made of the reproducibility of the electrolytic, thermal-electrolytic, and thermal types of the Ag-AgCl electrode in 0·05 *N* solution of KCl. The presence or absence of light, and of air dissolved in the solution, have no significant effect on their potentials. A marked ageing effect was noted, the origin of which was traced to concentration-polarisation occurring during the preparation of the electrodes. The attainment of concentration equilibrium between freshly prepared electrodes and solution is slow and may require from 1 to 20 days, depending on porosity of the electrodes and stirring of the solution. For the same reason, freshly prepared electrodes behave as kathodes towards aged electrodes, the initial difference in potential often exceeding 1 mV. When sufficient time is allowed for the establishment of concentration equilibrium, these types of Ag-AgCl electrodes assume the same potential, within about 0·02 mV. AUTHORS.

2995. Growth of Metal Trees in Gels. A. King and N. Stuart. *Chem. Soc., J. pp.* 642–654, *May*, 1938.—The growth of lead trees by displacement of lead from solution by less noble metals has been studied in the presence of silica gel. Detailed experiments, tin being used as the reducing metal, indicate that the morphology of the lead tree produced is fundamentally dependent on the concentration of lead in the gel, a wide variety of growth types being obtained. One of these is a new, spiriform type of growth which is characteristic of lead concentrations of 0·02 *N*

V.4
193

Lead trees produced by metals far removed from lead in the electrochemical series are similar in form among themselves, but different from that of the lead trees grown from tin; no spiriform growths are produced in this case. Colloidal materials in the gel have an inhibiting or modifying influence on the structure of the lead trees, which is unpredictable. AUTHORS.

See also Abstracts 2661, 2737 and

2109B. Solution of Rh by A.C. Electrolysis. E. Raub and G. Buss.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

2996. Proper Energy of the Electron. A. Mercier and T. Gustafson. *Comptes Rendus,* 206. *pp.* 1217–1219, *April* 20, 1938.—The series of successive approximations according to which the proper electrodynamic energy can be calculated is studed for the case of a free electron. N. M. B.

2997. Most-Probable Value of the Electronic Charge and other Related Constants for 1938. R. A. Millikan. *Ann. d. Physik,* 32. 1–2. *pp.* 34–43, *May,* 1938.—The most probable values and their estimated errors are at present: $e = 4{\cdot}796 \pm {\cdot}005{\cdot}10^{-10}$; $h = 6{\cdot}610 \pm {\cdot}012{\cdot}10^{-27}$; $N = 6{\cdot}097 \pm {\cdot}006{\cdot}10^{23}$. R. P.

***2998. Production of Very High Energy Electrons. K. Schwarz and F. Ebster.** *Akad. Wiss. Wien, Ber.* 146. 2*a*. 7–8. *pp.* 515–530, 1937.—An apparatus is described in which two Tesla coils operate on a discharge tube to produce electrons with energies up to 1·3 eMV. The mean energy of the electrons is determined by deflection in a magnetic field. The apparatus is applied to a brief examination of the passage of fast electrons through single crystals. F. C. C.

2999. Passage of Very High Energy Particles through Atomic Nuclei. W. Heisenberg. *N. Cimento,* 15. *pp.* 31–34, *Jan.,* 1938. *In German.*—Theoretical considerations of the passage of very high energy particles through an atomic nucleus lead to numerical values for the probabilities of high energy losses when such particles traverse Pb nuclei. For particles of energies 150–200 eMV the energy loss per cm. by the nuclear process varies from 1/5 to 1/10 of that lost by ionisation in Pb and Al respectively. F. C. C.

3000. Interaction of Elementary Particles. Part III. H. Yukawa, S. Sakata and M. Taketani. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 319–340, *April,* 1938. *In English.*—The new field of force introduced in two previous papers [see Abstract 1306 (1938)] was described in one paper by two four-vector functions, and in the other by two scalar functions. In the more amplified treatment given in the present paper linear equations (generalised Maxwell electromagnetic field equations) are constructed for the new field which is thus described by two four-vectors and two six-vectors, complex conjugate to each other respectively. This system of equations written in spinor form reduces to a special case of Dirac's wave equations for the particle with spin > 1/2. Quantisation is effected by constructing the commutation relations and the equations of motion, and the field variables are decomposed into Fourier components, each consisting of three components, indicating that the quanta accompanying this field have each spin 1. The interaction of the heavy quanta with the electromagnetic field is examined. The anomalous magnetic moments of the neutron and proton are probably due to the virtual presence of the heavy quanta in the intermediate states. The order of magnitude and the sign of the additional moment thus obtained agree with experiment. The possible forms of the interaction between the U-field and the heavy particle are considered and the force between the neutron and proton is deduced. The process of annihilation of a heavy quantum in free space by emitting a positive or negative electron and a neutrino or an antineutrino simultaneously is dealt with quantitatively and its bearing on the problem of the hard component of the cosmic rays is discussed. N. M. B.

3001. Inner Potentials of Graphite and Molybdenite. R. Uyeda. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 280–287, *April,* 1938. *In English.*—Precise values of mean inner potential of graphite and molybdenite were determined by analysing kathode-ray reflection spectra. They were found to be 13·0 V for graphite and 19·5 V for molybdenite. The apparent decrease of inner potential in low order reflections, which was first observed by Yamaguti, was studied experimentally in detail and compared with the theoretical values calculated by Bethe's theory. AUTHOR.

3002. Theory of Electron Diffraction. J. Farineau. *J. de Physique et le Radium,* 9. *pp.* 157–161, *April,* 1938.—The dynamical theory of the width of the diffraction maxima is considered and it is shown that the result depends very strongly on the boundary conditions for the transition of the electrons from the vacuum into the crystal. The boundary is usually represented as a sudden change of potential, but actually the potential rises gradually over a region of the order of a lattice spacing, which is large as compared to the wave-length. It is suggested that, if this be properly taken into account, a very much smaller figure would be obtained for the width of the maxima, and some rough estimates are given, which are in better agreement with observed values than the previous results. R. P.

3003. Electron Diffraction and the Kikuchi Envelope. Part II. E. Lamla. *Ann. d. Physik,* 32. 3. *pp.* 225–241, *June,* 1938.—Continuing previous work [see Abstract 2599 (1938)], further calculation is made on the theory of electron diffraction. More than two rays are considered and an explanation of the Kikuchi envelope is obtained. The results are applied to patterns of 50 kV electrons obtained by Finch by diffraction at spinel. F. C. C.

3004. Formation of Positron-Electron Pairs. K. Zuber. *Helv. Phys. Acta,* 11. 3. *pp.* 207–218, 1938. *In German.*—By means of an automatically recording Wilson chamber an investigation has been made of the effect of γ-radiation from a RaTh source on A. The accuracy of the energy measurements, which is determined principally from the multiple scattering of the positive and negative electrons produced at the atomic nuclei, is discussed and it is shown that the amount of the multiple scattering can be determined from the curve of distribution of the pair energies. Besides the pairs which are produced by the action of $2\cdot62 \times 10^6$ eV γ-radiation, other pairs are found whose origin is due to γ-radiation of $(3 - 3\cdot4) \times 10^6$ eV energy. For the difference between the mean energies of the positrons and electrons, a value is found larger than that calculated by Hulme and Jaeger. The angle between the γ-rays and the pair particles follows a course which agrees with the theory of Bethe and Heitler. G. O. B.

3005. Secondary Electron Emission from Complex Kathodes of Rb and K. P. Timofeev and A. Pjatnizki. *Techn. Phys., U.S.S.R.* 4. 11–12. *pp.* 945–952, 1937. *In German.*—By the method previously applied to complex kathodes of Cs [see Abstract 2863 (1937)] it is shown that the secondary emission of Rb and K is less than that of Cs. It was found that the secondary emission of complex surfaces depends mainly upon the temperatures, but the extent of this effect in the case of clean metal surfaces was not investigated. A. G. Q.

3006. Secondary Emission of Thin Films of Alkali Metals upon Au, Ag and Pt Substrates. A. Afanasjeva and P. Timofeev. *Techn. Phys., U.S.S.R.* 4. 11–12. *pp.* 953–960, 1937. *In German.*—The secondary emission of the alkali metal films is found to pass through a maximum as the thickness of the layer is increased. The increase in secondary emission compared with that of the substrate is only about 10%, whilst the photoelectric current is increased many times. It is concluded that the secondary emission is mainly governed, not by the work function of the surface film but by the structure of the underlying layers. Reduction of the work function only results in increased secondary emission when the two substrates have similar structures. In view of the results obtained the fundamental difference between the liberation of photoelectrons and secondary electrons is emphasised. A. G. Q.

3007. Elastic and Inelastic Scattering of Fast Neutrons. D. C. Grahame and G. T. Seaborg. *Phys. Rev.* 53. *pp.* 795–801, *May* 15, 1938.—Cross-sections for the combined processes of absorption + inelastic scattering of fast neutrons ($E \gg 4\cdot5$ eMV and $E \gg 7$ eMV) have been measured for a number of elements by the use of absorbing cylinders and Al or Fe detectors. A smooth increase with increasing atomic number is found. For neutrons of energies $\gg 7$ eMV the ratio of these cross-sections to the cross-sections for absorption + total scattering (Dunning) is nearly constant at a value of about 0·4. The existence of a scattering of fast neutrons in which little or no energy is lost has been demonstrated experimentally and approximate cross-sections for the process have been obtained. Cross-sections for an "effective absorption" of medium fast neutrons have also been determined. These cross-sections, which are smaller than those obtained for the faster neutrons mentioned above, show a maximum at about $Z = 50$ and a marked decrease for the heaviest elements. The cross-sections obtained by Aoki and Lea from experiments on the yield of γ-rays from the action of fast neutrons on matter are in agreement with the present results. [See also Abstract 4260 (1937).] AUTHORS.

3008. Absorption of Slow Neutrons in Dysprosium and Cadmium. J. J. Gurevich and M. G. Meščerjakov. *Phys. Zeits. d. Sowjetunion,* 13. 2. *pp.* 151–169, 1938. *In English.*—It is shown that Dy absorbs, besides C-neutrons, neutrons of 0·6 eV energy. The neutrons absorbed by Dy are mainly captured by Dy^{164}. The position and width of the resonance band for the absorption of neutrons in Cd are found. AUTHORS.

3009. Geometrical Electron Optics. W. Henneberg. *Naturwiss.* 26. *pp.* 302–304, *May* 13, 1938.—A brief review is given of the development of the theory of electron optics and of its numerous applications. H. J. H. S.

•3010. Electron Microscope for High Magnifications. A. K. Nuttall. *M.V. Gazette,* 17. *pp.* 256–259, *May,* 1938.—The principle and general construction of a continuously evacuated h.v. electron microscope is described. The instrument, which has magnetic focusing, has two stages, each fitted with an observation window and camera and a rotatable head whereby the same region of the object may be examined either with an optical microscope or with the electron microscope. The normal accelerating potential is 20–50 kV. Adequate provision is made for centring and adjustment of the magnetic lenses and compensating coils are fitted to neutralise the earth's field. Evacuation is effected by two Metrovac oil condensation pumps in series, backed by a Metrovac D.R.I. rotary pump; this system is capable of maintaining a high vacuum in the tube even although the pressure in the cold kathode discharge tube is of the order of 0·1 mm. Hg. Satisfactory images are obtained at a magnification of 1500 dia. but it is considered that this figure is likely to be increased considerably. H. J. H. S.

See also Abstracts 2647, 2649, 2848, 2849, 2857, 2948, 2968, 2969, 3024 and
2128B. Theoretical Principles of Electron Optics. R. Sartori.
2130B. Negative-Ion Components in the Kathode-Ray Beam. C. H. Bachman and C. W. Carnahan.
2331B. Electron Motion in Dynamic Multiplier. W. Majewski.
2332B. Secondary Electron Emission. H. Bruining.

ELECTROSTATICS.

See Abstracts 2740, 2743, 2975, 3037.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

3011. The Four Magnetic Transverse Effects in Copper and their Changes with Temperature. E. H. Hall. *Am. Acad., Proc.* 72. 9. *pp.* 301–325, *April,* 1938.—Careful re-measurements were made of the four magnetic transverse effects for copper (Hall effect, R, Ettingshausen effect, P, Nernst effect, Q, and Leduc effect, S). The apparatus and methods used are fully described. The results obtained at three different temperatures are given in the following table.

Temp.	$R \times 10^4$	$P \times 10^9$	$Q \times 10^4$	$S \times 10^7$
25° C.	− 5·36	− 1·446	− 2·155	− 2·698
55°	− 5·37	× 1·544	− 2·104	− 2·448
85°	− 5·38	− 1·674	− 2·014	− 2·272

A. W.

3012. Dependence of Resistance of Nickel Crystal on Direction of Magnetisation. W. Döring. *Ann. d. Physik,* 32. 3. *pp.* 259–276, *June,* 1938.—The first part of the paper is a theoretical treatment in which, from consideration of the symmetry of the crystal, the general form of the dependence of the resistance of cubic ferromagnetic crystals on the directions of current and magnetisation is derived. An expression is obtained for the effect which contains five constants. These can be experimentally determined from observations of the saturation values of the transverse and longitudinal resistance changes of single crystal rods. In the second part the results of resistance measurements on eight nickel crystals are given. These fit the theory and the necessary constants are deduced from measurements of the relative resistance changes for three directions of current and three directions of magnetisation. R. W. P.

See also Abstract 2937.

MAGNETISM AND ELECTROMAGNETISM.

3013. Paramagnetic Magneton Numbers of the Ferromagnetic Metals. E. C. Stoner. *Leeds Philosoph. and Lit. Soc., Proc.* 3. *pp.* 457–464, *April,* 1938.—The experimental results of Sucksmith and Pearce (*Nature,* 140 *p.* 970, *Dec.* 4, 1937) on the susceptibility of Fe, Co and Ni above the Curie point are discussed in the light of a collective electron treatment of ferromagnetism using Fermi-Dirac statistics. The magneton numbers obtained by the conventional method from the slope of approximately linear portions of $1/\chi$, T curves are considerably greater than those anticipated from the low temperature saturation magnetisation. From the point of view of the new treatment, the conventional magneton numbers have little immediate significance. It is shown that the general character of the $1/\chi$.T curves is in agreement with this treatment, and that the observed susceptibilities over the whole range are consistent with a number of holes in the d electron energy bands only slightly greater than the number of parallel spins at low temperatures, the factor probably not exceeding 10/9. Estimates of the ratio of the interchange interaction energy to the Fermi energy, $k\theta'/\epsilon_0$, and of $k\theta/\epsilon_0$, where θ is the Curie temperature, may be made from the results. The estimate of ϵ_0 obtained in this way for Ni is in good agreement with the value deduced from the electronic specific heat at low temperatures. AUTHORS.

***3014. Applications of Intense and Extended Magnetic Fields in Recent Researches. A. Cotton.** *N. Cimento,* 15. *pp.* 23–30, *Jan.,* 1938. *In French.*—Descriptions, with illustrations, are given of the improvements in the Bellevue electromagnet for obtaining very intense and also extended fields (large enough to embrace a Wilson cloud chamber of dimensions 75 × 20 × 4 cm.). A project is also described for constructing a large powerful permanent magnet which may be magnetised to a known degree. The field, once created, will then not require the expenditure of large amounts of power to maintain its magnetisation; this will facilitate long period observations under constant field conditions. A number of applications of such a magnet are suggested. H. J. H. S.

3015. Phenomena in Iron-Cored Circuits. W. S. Stuart and T. G. Bridgwood. *Leeds Philosoph. and Lit Soc., Proc.* 3. *pp.* 500–507, *April,* 1938.—Iron-cored coils in association with capacity are liable to instability in a.c. circuits since the inductance of the coils is dependent on the current flowing. Graphical methods based on the volt-ampere characteristics of the circuit components are used to analyse this instability. Observations with an oscillograph show that the instability is accompanied by a continual change of wave shape of both current and voltage; in addition, in many circuits oscillations of relatively high frequency may occur and these may be considered as being initiated by periodic impulses produced by non-linearity of the magnetisation characteristic of the iron. H. J. H. S.

3016. Magnetic After-Effects in Weak Alternating Fields. Parts I, II and III. H. Schulze. *Wiss. Veröff. a. d. Siemens-Werken,* 17. 2. *pp.* 39–73, 1938.—In Part I the magnetic properties of recrystallised carbonyl Fe are described. Two types of after-effect are observed; superimposed on the well known Jordan effect there is a marked temperature and frequency effect. For a given frequency, the temperature relation gives a type of resonance curve the maximum of which is displaced towards higher temperatures as the frequency increases and at the same time it diminishes in magnitude. Ballistic measurements at low temperatures show no after-effect but a.c. measurements show the usual Jordan effect which is independent of frequency and which varies only slightly with temperature. The after-effect is considerably decreased by magnetising to saturation whilst the properties after demagnetisation are not the same as originally. In Part II the effect of mechanical treatment on the after-effect is described. It is shown that the temperature and frequency component only appears in the recrystallised condition. Part III deals with the influence of annealing treatment on the demagnetised material; by annealing for 2 hr. at 450° C. the after-effect shown by the demagnetised material may be brought back to its initial value but in this state it is not as stable as in the original condition. H. J. H. S.

3017. Magnetic Binding. O. v. Auwers. *Wiss. Veröff. a. d. Siemens-Werken*, 17. 2. *pp.* 74–93, 1938.—In continuation of an earlier paper [see Abstract 5105 (1937)], a simple relation is derived between the Curie temperature and the magnetic moment; a physical interpretation is attempted. The effect of the lattice structure on the sign of the exchange integral and of its importance in the macroscopic theory of ferromagnetism is discussed. The results of this and of the preceding papers are applied to an analysis of the magnetic properties of the Heusler alloys in which particular mention is made of the effect of thermal treatment on the magnetic behaviour and of the problem of coercive force. H. J. H. S.

3018. Magnetic and X-Ray Examination of Ni-Pt Alloys. A. Kussmann and H. Nitka. *Phys. Zeits.* 39. *pp.* 373–375, *May* 1, 1938. *From the Reichsanstalt.*—A superstructure corresponding to Ni$_3$Pt is shown to exist in the Ni-Pt system. It is produced from the solid solution by annealing at 450° C. and differs from its parent solution by a higher electrical conductivity, a lower Curie point and a smaller magnetic saturation. H. J. H. S.

3019. Magnetic Structure of Co. W. C. Elmore. *Phys. Rev.* 53. *pp.* 757–764, *May* 1, 1938.—The magnetic structure of Co crystals at room-temperature is studied by depositing a stable colloid of γ-ferric oxide on crystal sections, suitably prepared, by means of a normally applied magnetic field. In this way, three related patterns are obtained corresponding to no field and to an outward and inward field direction. The pattern varies with the section and a description of some of them is given; the patterns so obtained do not seem to agree with those expected by simple theory but a modification is proposed which accounts for them. The processes involved in the transition of a crystal from the fully magnetised to the demagnetised state is described in terms of the dendritic growth of regions of reversed magnetisation. H. J. H. S.

3020. Magnetic Properties of Small Metallic Specimens at Low Temperatures. F. Hund. *Ann. d. Physik*, 32. 1–2. *pp.* 102–114, *May*, 1938.—Metallic specimens of certain size show strong diamagnetic properties at low temperatures and in weak magnetic fields; their behaviour is similar to those of supraconductors. In ring shaped specimens, a current round the hole is associated with the diamagnetic property. It is shown that the usual separation of the electric current into a conduction current with energy dissipation and an Ampère-Weber current without energy dissipation but without total current over the whole cross-section is a sufficiently near approximation for all practical purposes. H. J. H. S.

3021. Crystallisation and Thermomagnetic Anomaly of Lepidocrocite. A. Michel and M. Gallissot. *Comptes Rendus*, 206. *pp.* 1252–1254, *April* 25, 1938.—Thermomagnetic curves of various preparations of lepidocrocite show that the magnetisation of the well-crystallised variety is much greater than that of the fine-grained variety. This latter on heating at, say, 400°, passes gradually into the well-crystallised variety, and at the same time its magnetisation increases. This increment in magnetisation at a constant temperature is the anomaly, which is greater the more fine-grained the original lepidocrocite was. C. A. S.

3022. Susceptibility of Liquid NO. H. Bizette and B. Tsaï. *Comptes Rendus*, 206. *pp*. 1288–1289, *May* 2, 1938.—Determined by Dupouy and Haenny's method [see Abstract 1364 (1936)] the magnetic susceptibility of liquid NO at $-163°$ is $3 \cdot 53 \times 10^{-6}$. This indicates approximately 97% polymerisation and agrees well with the 93% indicated by the magnetic rotatory power [see Abstract 3522 (1937)]. C. A. S.

3023. Susceptibility of Paramagnetic Alums in Alternating Fields. M. Fierz. *Physica*, 5. *pp*. 433–436, *May*, 1938.—In alums of the iron group, an alternating h.f. field applied along with a strong constant parallel field causes a partial suppression of the paramagnetism of the alum [see Abstract 4208 (1937)]. There is, however, a residual magnetism which follows the h.f. field. With reference to this the writer points out that by modifying Waller's formula [see Abstract 772 (1933)], for C, the number of spin reversals (*Spinumklappungen*) per sec., to suit the condition that the effect of elastic waves on the dipoles is chiefly an indirect one due to a change in the internal electric field, the value of C may be roughly estimated at $5 \times 10^{-10}\,T^7 \times I$. I is an integral which has the magnitude 1 when T is 90° Abs., giving C a value of the order 10^4. G. E. A.

3024. Paramagnetic Conversion of Parahydrogen and Orthodeuterium in the Presence of Nitric Oxide and the Magnetic Moment of the Deuteron. L. Farkas and U. Garbatski. *J. Chem. Phys.* 6. *pp*. 260–263, *May*, 1938.—The rates of the reactions $p\text{-}H_2 + NO \rightleftharpoons o\text{-}H_2 + NO$ (1) and $o\text{-}D_2 + NO \rightleftharpoons p\text{-}D_2 + NO$ (2) are compared. According to Wigner's theory the ratio of the velocities should be proportional to μ_H/μ_D where μ_H and μ_D are the magnetic moments of H and D. The ratio of the rates is in approximate agreement with Wigner's theory and also with the theory of Kalckar and Teller; no decision can be made regarding which of these theories is the better approximation. The velocity constant of (1) is about 10 times that of (2) at the same temperature. Comparison of the conversion rates of both reactions with those in the presence of O_2 shows that the ratios are the same but that the rates in NO are about five times the rates in O_2. Assuming $\mu_H = 2 \cdot 46$ nuclear magnetons, and $\mu_H/\mu_D = 3 \cdot 8$, $\mu_D = 0 \cdot 65$ nuclear magneton; this value is compared with recorded values. W. R. A.

3025. Diamagnetism of Cadmium. S. R. Rao and S. Sriraman. *Roy. Soc., Proc.* 166A. *pp*. 325–341, *June* 3, 1938.—Single crystals of Cd were prepared by the method of slow cooling and the principal magnetic susceptibilities were determined by the Gouy method. The influence of ferromagnetic impurities on the observed values was eliminated by determining the susceptibilities at different field strengths in accordance with Honda's method. The mean values perpendicular and parallel to the hexagonal axis of the crystal were found to be $-0 \cdot 163$ and $-0 \cdot 223$ respectively. The magnetic anisotropy was $1 \cdot 368$ and the mean diamagnetic susceptibility for a polycrystalline aggregate $-0 \cdot 183$. The value $-0 \cdot 163$ of $\chi_{\perp}$ is close that of McLennan, Ruedy and Cohen but the author's value of $\chi_{\parallel}$ is lower than theirs. This makes the magnetic anisotropy of Cd much nearer that of Zn than the earlier values indicated. The influence of cold-working on polycrystalline rods and single crystals of Cd was investigated. In the case of polycrystalline specimens, a small decrease was obtained. On the other hand, the principal susceptibilities measured with single crystals showed no variation on cold-working. The influence of small quantities of foreign matter was also a subject of investigation. Pb when added in small amounts affected the principal susceptibility normal to the *c* axis but not the value parallel to this axis. The principal susceptibilities did not alter as a result of adding small quantities of Zn. These results are examined in the light of the theory of paramagnetism of free electrons developed by Pauli, Landau and Peierls. The valency electrons appear to contribute a paramagnetic component perpendicular to the *c* axis. There is evidence for this from electrical conductivity data. The results obtained with the alloys are examined in the light of these conclusions. AUTHORS.

3026. Use of Potential in Born's Electrodynamics. Z. Chrapływy. *Acad. Polonaise Sci. et Lettres, Bull.* 9–10A. *pp.* 509–520, *Nov.–Dec.,* 1937. *In German.*—In Born's electrodynamics, and in any other similar theory in which the deviations from the Coulomb law start at a distance equal to the classical electron radius from the electron, the correction terms in the fine structure of the H lines is much less than the discrepancy between theory and experiment. In this calculation, one must not insert for the interaction energy between two charged particles the potential from which the field intensity is derived, but it is necessary to calculate the total electrostatic field energy as a function of the distance of two charges. R. P.

***3027. Screened Sub-Standard Inductometer. N. F. Astbury and L. H. Ford.** *Phil. Mag.* 25. *pp.* 1009–1025, *June,* 1938.—The design and construction of a completely screened variable mutual inductance of high stability are described. The instrument has a range of 10,000 μH, and changes of 0·01 μH can be read. Double screening renders the properties of the instrument independent of the circuit in which it is used. A novel method of adjustment of the sections is described, together with a novel form of inductance slide-wire. The instrument is compensated for phase defect, which even at 3000 c.p.s. is only 0·0005 radian at the maximum setting. The variation of mutual inductance with frequency is also low, being less than 4 parts in 10^4 at 1000 c.p.s. The method of calibration is described, the limits of error being $\pm 0{\cdot}02\mu$H throughout the range. The instrument is admirably suited for high precision a.c. bridge measurements of all kinds. AUTHORS.

See also Abstracts 2650, 2710, 2716, 2935.

MEDICAL RADIOLOGY AND ELECTROLOGY.

3028. Electrical Excitation of the Human Heart with a Natural Impulse of Rhythm. H. E. Hollmann. *Zeits. f. techn. Physik,* 19. 6. *pp.* 155–158, 1938.—The bio-electric variations during contraction of the heart muscle have hitherto been employed exclusively for diagnostic purposes in medicine, in respect to the electro-cardiograph. The author proposes to control the heart pulsation for therapeutic purposes by application of electrical potentials applied rhythmically in accordance with the normal pulsation, in cases where normal pulsation is defective. For this purpose an intensifying thermionic apparatus, employing a negative resistance, is used to amplify the bio-electrical variation of the heart and reapplied by means of electrodes, as used with the electro-cardiograph, to the heart. The schematic arrangement of the apparatus is shown, together with various modes of application to the patient, with typical curves of the electrical variations. The author expresses the view that the method under medical control is capable of wide application, and offers an advance over various existing electrical methods of therapy employed in this respect. B. J. L.

3029. Back Scatter and Dosage. R. S. Landauer. *Radiology*, 30. *pp.* 629–632, *May*, 1938.—The physical processes underlying scattering are discussed and it is shown how the amount of scattered radiation increases the apparent dose. Measurements are made in which the percentage of back scattered radiation in the total dose is determined; it varies markedly with wave-length and field size. The effect of making measurements in air, in order to obtain data applicable to depth dosages in body tissue is considered and the importance of a real understanding of the corrections involved is stressed. Many numerical examples are given. G. G.

3030. Back Scatter. E. H. Quimby, L. D. Marinelli and J. H. Farrow. *Am. J. of Roentgenology and Radium Therapy*, 39. *pp.* 799–815, *May*, 1938.—In radiation therapy, a certain proportion of the radiation incident upon the patient is scattered and so reflected backwards, modifying the dosage actually received by the patient. Thimble ionisation chambers have been used to measure the intensity of this back scatter and errors of measurement occur. The authors present extensive graphic and tabular data of measurements carried out with a thimble chamber and the Failla extrapolation chamber which is free from most of the errors obtained with thimble chambers. For the particular thimble chamber used the measurements with hard radiations, show higher values than with the extrapolation chamber, although this is reversed for soft radiation. The data obtained are only applicable to the particular thimble chamber used and the back scatter, with both chambers used, shows a maximum for a voltage of radiation having a half-layer value about 0·5–0·6 mm.Cu. The amount of underlying material necessary to produce maximum back scatter increases with ray hardness and is rapid for soft rays and slow for hard rays. Change of target-skin distance in respect to back scatter has been investigated. For soft rays there is no great variation from 30 to 60 cm. and for hard rays from ·40 to 150 cm. Results in this respect of other investigators published during the past ten years are tabulated and variations discussed, together with the application of the data to determine the skin dose. B. J. L.

***3031. Short-Wave X-Rays. W. D. Coolidge.** *Radiology*, 30. *pp.* 537–543, *May*, 1938.—This paper gives a survey of the growth of X-ray technique and a description of the physical processes underlying the production of X-rays. Modern h.v. X-ray tubes, which require constant pumping, are described; among them is a recent one which is run at 800,000 V. The focusing action and the filament arrangements of such tubes are discussed. The question of an a.c. source of supply and its rectification is also considered. The "impulse generator," which can be used to give up to 10,000,000 V is also mentioned and its disadvantages pointed out. G. G.

***3032. Focalograph. E. K. Reid, L. F. Black.** *Radiology*, 30. *pp.* 625–628, *May*, 1938.—This paper describes a device for the examination of the target of an X-ray tube, by providing a record of the appearance of the target, demonstrating the effect of the angular position of the target, checking the effective area of the focal spot (and thus checking specification claims) and determining the maximum ray divergence and the minimum focal film distance for various types of tubes. It consists essentially of a perforated lead diaphragm which is placed between the tube and the photographic film. Examples are given of the results obtained from a series of different tubes. G. G.

3033. Physics and Biology of Radiation Effects on Genes. P. Jordan. *Phys. Zeits.* 39. *pp.* 345–366, *April* 15, 1938.—A general survey is made of the problem of radiation effects on biological materials, and it is pointed out that the basis of all effects must be ionisation and excitation processes. It is shown that in organic material receiving a radiation dose of 1000 *r*, the probability of ionisation of any atom is 4×10^{-8}. The case of the passage of a fast electron through H_2 is considered in detail, and the theory then extended to other materials. In general it is shown that tertiary ionisation forms 1/3 of the total ionisation and that the ratio excitations/ionisations = 2 in most cases. From these facts it is concluded that the ionisation track of a fast electron is interspersed with groups of at least 3 ionisations and 6 excitations enclosed in a volume containing some 10^3 atoms. These groups are probably the effective agents in biological processes. Section II of the paper is devoted to discussion of the analysis of mortality curves obtained on irradiating biological objects. The analysis of the cases considered supports in general the theory of the biological effectiveness of groups of ions. In the remainder of the paper the theories put forward are applied to the problems of chromosome changes and gene mutations. The argument is put forward that a gene is a single large molecule and that a mutation consists of the removal or addition of a comparatively simple radical. This theory is supported by the apparently " quantised " nature of gene mutations. The applications of the theory to radiation genetics are discussed in Section IV. J. E. R.

See also Abstract 2922.

OSCILLATIONS AND WAVES.

3034. Electrical Oscillations of a Prolate Spheroid. Part I. L. Page and N. I. Adams, Jr. *Phys. Rev.* 53. *pp.* 819–831, *May* 15, 1938.—Solutions in spheroidal coordinates of the differential equation of the electromagnetic field are obtained which are valid all the way from the surface of a prolate spheroid of eccentricity unity to infinity. The wave-length λ and logarithmic decrement δ of the fundamental free oscillations are computed for all eccentricities. The wave-length λ, current I, and phase ϕ at resonance are computed for six eccentricities near unity for an aerial stimulated by a uniform field varying sinusoidally with the time. Three resonance curves are computed, the radiation resistance at resonance is calculated for six eccentricities and off resonance for two. Expressions for the entire field at all points are given, and reduced to explicit form for the radiation field. An expression is obtained for the mean rate of radiation. AUTHORS.

3035. Propagation of Radio Waves over a Finitely Conducting Spherical Earth. B. van der Pol and H. Bremmer. *Phil. Mag.* 25. *pp.* 817–834, *June*, 1938. *Supplement.*—An extension is given to the applications in the radio case of a general theory treated in two former papers [see Abstract 5481 (1937)] on the problem of diffraction of electromagnetic waves round an absorbing sphere. Asymptotic series have been derived from which the numerical constants occurring in the final formula may be calculated for the field strength of a sender emitting waves over a homogeneous sphere with arbitrary electrical conductivity and dielectric constant; the sender and receiver are hereby supposed to be situated on the earth. The general results are compared with those of Eckersley and Wwedensky, treating the same problem. Finally, curves are given showing the field strength as a function of the distance for propagation over sea-water and over average soil. AUTHORS.

See also Abstract 2984 and

2131B. Recurrent Surge Oscillograph. G. J. Scoles.
2296B. Reflection and Absorption of Decimetre Waves at Plane Dielectric Layers. W. Dällenbach and W. Kleinsteuber.
2297B. Reflection by Layered Media. W. Pfister and O. H. Roth.
2300B. Attenuation and Group Retardation in Ionosphere. G. Millington.
2301B. Upper Atmospheric Ionisation and Solar Radiation. K. Maeda.
2303B. Ionosphere during Northern Lights, 25-26 Jan., 1938. R. Eyfrig, G. Goubau, T. Netzer and J. Zenneck.
2304B. Stability of 2m. Waves. R. Burrows, A. Decino and L. E. Hunt.
2318B. Metallic Ellipsoid as Frequency Stabiliser. K. Morita.
2326B. Resotank Generator for Microwaves. A. Allerding, W. Dällenbach and W. Kleinsteuber.

PHOTOELECTRICITY.

***3036. Photovoltaic Cells and Their Applications. W. Behrendt.** *Zeits. f. techn. Physik*, 19. 4. *pp.* 92–97, 1938.—The performance of a large number of photovoltaic cells of one manufacture has been examined and it is found that the cells can be divided into six fairly well-defined groups. The characteristics of each group are tabulated, particularly (*i*) the range of illumination over which the characteristic curve is sensibly linear, (*ii*) the sensitivity in terms of (*a*) μA per lumen and (*b*) mV per lux, (*iii*) the fatigue at various illuminations, (*iv*) the sensitivity with 4 volts external p.d., (*v*) the ageing effect in 80 days at 70° C. From the results obtained suggestions are made as to the suitability of cells of the different classes for the various purposes to which photovoltaic cells are applied, *e.g.*, precision photometry, illumination measurement, use with photographic exposure meters, sound films, light relays, etc. J. W. T. W.

3037. Photoelectrets. G. Nadjakoff. *Phys. Zeits.* 39. *pp.* 226–227, *March* 15, 1938.—A new kind of permanent polarisation of some dielectrics under simultaneous application of light and electric field is described. Such polarisations are only possible in dielectrics (*e.g.*, sulphur) which exhibit a characteristic photo-conductivity. The dielectric is described as in the photo-permanent-polarised condition, in contra-distinction to the thermo-permanent-polarised condition previously described. J. J. S.

See also Abstracts 3005, 3006, and
2255B. Photoelectric Emission. G. Todesco.

PIEZOELECTRICITY.

See Abstract 2841.

THERMIONICS.

3038. Shot Effect with Space Charge. J. M. Whittaker. *Cambridge Phil. Soc., Proc.* 34. *pp.* 158–166, *April*, 1938.—A general discussion is given of the Johnson effect and shot effect as disturbing influences in valve amplifiers. The effect of space charge is to diminish the shot effect, probably by the smoothing out of fluctuations in the anode current. Available theory is reviewed, and a mathematical theory is developed in this paper endeavouring to take into account conditions at the kathode and also in the space charge. It is based on the principles that the fluctuations in the stream of electrons are smoothed on their way to the anode by the passage through the space charge, and that the anode has a power of regulating the supply of electrons it accepts ; this process applies a further smoothing to the fluctuations. [See also Abstract 4956 (1937).] N. M. B.

3039. Thermionic Emission From Carbon. A. L. Reimann. *Phys. Soc., Proc.* 50. *pp.* 496–500, *July* 1, 1938.—Observations of the thermionic emission from a carefully outgassed filament of graphitic carbon were made at a series of temperatures between 1665° and 2191° K. The corresponding values of the constants A and ψ in the empirical emission formula $i = \mathrm{A}T^2\epsilon^{-\psi/kT}$ were found to be 30 $\mathrm{A/cm^2.\text{-}deg^2}$. and 4·34 eV respectively. AUTHOR.

THERMOELECTRICITY.

3040. Thermo-E.M.F. of a Supraconductor against the Same Metal in the Non-Supraconductive State. W. H. Keesom and C. J. Matthijs. *K. Onnes Lab., Leiden, Comm. No. 252e. Physica,* 5. *pp.* 437–448, *May,* 1938. *In English.*—In connection with the fact that the thermo-e.m.f. in a thermocouple consisting of a supraconductor A and another metal B, are affected by a magnetic field [see Abstract 1366 (1938)], the authors have examined whether there is a thermo-e.m.f. in a thermocouple in which the metal B has been replaced by the same metal A, but with supraconductivity disturbed by a magnetic field. Experiments were made on Sn and In. For both metals a thermo-e.m.f. as mentioned was found. For In the agreement with the previous results is good. For tin such a comparison could not be made for want of experimental data. The results of the present experiments were further compared with the formula for the thermo-e.m.f. for this case given by Kok [see Abstract 2865 (1937)] and on broad lines agreement was found. AUTHORS.

3041. Thermoelectric Effects in Homogeneous Conductors. M. Fraser. *Phil. Mag.* 25. *pp.* 785–793, *May,* 1938.—The ends of a Cu wire or fine column of Hg are connected with the terminals of a galvanometer, the wire or column is then asymmetrically heated and the current flowing in the galvanometer is observed. The results indicate that such e.m.f.'s as were observed were not due to asymmetric heating. They contradict the conclusions of Benedicks and of Feng and Band, who hold that e.m.f.'s are produced when a homogeneous conductor is heated non-uniformly (the so-called Benedicks effect). The e.m.f.'s observed are ascribed to non-homogeneity of the conductor, due either to strain or lack of annealing. J. S. G. T.

3042. Temperature Distributions of Linear Conductors Heated by Current or by Radiation. J. Fischer. *Zeits. f. techn. Physik,* 19.3. *pp.* 57–63, *and* 19.4. *pp.* 105–113, 1938.—In this paper earlier results [see Abstract 2202 (1938)] are applied to determine the temperature distribution of a linear conductor, which has the ends held at the temperature of the surroundings and is heated electrically. Allowance is first made for the separate effects of convective heat transfer and of radiation losses, and then for their combined effects. The variable state is dealt with, distributions being derived at various times after the heating current has been applied or removed. Several examples are included illustrating the manner in which the suggested methods can be applied to a number of physical problems of practical importance. R. W. P.

See also Abstract 2937.